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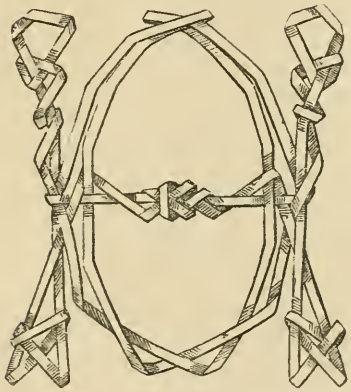

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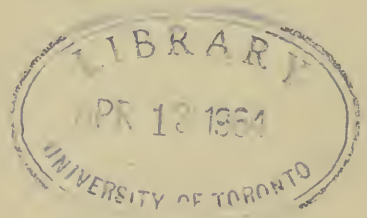

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CONTENTS

OF

THE ELEVENTH VOLUME.

PART I.

ORIGINAL CONTRIBUTIONS.

	PAGE
1. E. NETTLESHIP, F.R.C.S., On the Pathological Changes in Syphilitic Choroiditis and Retinitis. (Illustrated)	1
2. ARTHUR H. BENSON, F.R.C.S.I., The More Modern Operations for Trichiasis	18
3. W. JENNINGS MILES, F.R.C.S., Curator's Pathological Report.	
Part I. Detachment of the Vitreous Body	26
„ II. Cases of Intra-Ocular Sarcoma producing Sympathetic Ophthalmitis	43
„ III. Two Cases of Sympathetic Inflammation of the Eyeball	48
4. W. A. BRAILEY, M.D., Intra-Ocular Sarcoma exciting Sympathetic Disease	53
5. E. NETTLESHIP, F.R.C.S., Miscellaneous Observations and Cases	55
6. R. MARCUS GUNN, M.A., F.R.C.S. On Sympathetic Inflammation of the Eyeball (with Pathological Notes by W. A. BRAILEY, M.D.)	78

PART II.

ORIGINAL CONTRIBUTIONS.

7. W. LANG, F.R.C.S., and JAMES W. BARRETT, M.B., The Refractive Character of the Eyes of Mammalia	103
8. W. LANG, F.R.C.S., and JAMES W. BARRETT, M.B., The Action of Myotics on the Accommodation. (With Charts)	130
9. J. HUTCHINSON, JUN., F.R.C.S., On a Case of Unsymmetrical Tobacco-Amaurosis	188
10. J. HUTCHINSON, JUN., F.R.C.S., Relapsing Optic Neuritis, with Development of New Vessels in Front of the Papilla. (Illustrated)	191
11. J. B. LAWFORD, M.D., F.R.C.S., Curator's Pathological Report.	
Part I. On Eyes containing Foreign Bodies at the Time of Excision	196
„ II. On Cases of Cystic Degeneration of the Retina. (Illustrated)	208
12. J. HUTCHINSON, JUN., F.R.C.S., On a Case of Peripheral Choroido-Retinitis associated with Peculiar Pigmentation of Mucous Membranes. (Illustrated)	216

Part III.

ORIGINAL CONTRIBUTIONS.

PAGE

13. W. Lang, F.R.C.S., and James W. Barrett, M.B., The Action of Myotics and Mydriatics on the Accommodation. (With Charts) 219
14. E. Nettleship, F.R.C.S., Miscellaneous Cases, continued from page 77. (Illustrated) 260
15. R. Marcus Gunn, M.A., F.R.C.S., On Sympathetic Inflammation of the Eyeball (with Pathological Notes by W. A. Brailey, M.D.), continued from p. 102 273
16. J. B. Lawford, M.D., F.R.C.S., Curator's Pathological Report: On Cases of Dislocation of the Crystalline Lens. (Illustrated)..... 327
17. E. Treacher Collins, Notes on In-Patients 338
    I. Cases of Interstitial Keratitis with Corneal Ulceration 338
    II. Treatment of Granular Ophthalmia with Carbolic Acid 340
    III. Statistics of Cataract Operations before and since the Introduction of Cocaine 341
18. W. J. Collins, M.D., M.S., Miscellaneous Cases and Observations. 343
19. R. Marcus Gunn, Note on certain Retinal Reflexes visible with the Ophthalmoscope. (Illustrated) 348

Part IV.

ORIGINAL CONTRIBUTIONS.

20. E. Nettleship, F.R.C.S., On Some of the Forms of Congenital and Infantile Amblyopia 353
21. J. B. Lawford, M.D., F.R.C.S., Curator's Pathological Report. Cases of Intra-ocular Sarcoma (Illustrated) 400
22. E. Treacher Collins, On Anophthalmos..... 429
    Index to Volume XI 457

The Royal London

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Part I.

Original Contributions.

ON THE PATHOLOGICAL CHANGES IN SYPHILITIC CHOROIDITIS AND RETINITIS.

(With Plates I, II, III, IV.)

By E. Nettleship, F.R.C.S.,

Ophthalmic Surgeon to St. Thomas's Hospital; Assistant Surgeon to the Royal London Ophthalmic Hospital.

Although from time to time opportunities must have occurred to many of examining specimens of active syphilitic disease of the choroid and retina, and though many other observers are doubtless familiar with specimens like those described below, I do not know that any series of illustrations of the morbid changes in question has been published. Even in one of the latest and most elaborate monographs* on syphilitic diseases of the choroid and retina, in which the literature of the subject has been very thoroughly worked up, but little space is given to the pathological anatomy of such cases. Whilst not hoping to add anything new to the natural history of these affections, I believe that the illustrations now given will be of interest, since they are carefully

* Ole Bull (of Christiania), "The Ophthalmoscope and Lues." 1884.

drawn from good sections of specimens, the clinical history of which is tolerably complete.

The *changes in the choroid* in syphilitic choroiditis are such as the ophthalmoscopical appearances would lead us to expect; we find collections of cells in the choroid, similar effusions between this coat and the retina, and attenuation of the choroidal structures following absorption of the inflammatory products; multiplication of the pigmented epithelial cells which, though morphologically belonging to the retina, are for the purposes of descriptive anatomy more conveniently retained as part of the choroid, can be well made out in some specimens. So far as I have seen, the choroidal changes always begin in, never upon, this tunic, the exudations upon its retinal surface occurring later from extension inwards of luxuriant cell growth; indeed, that such epichoroidal growths occur at all is perhaps due to the inflammation of the choroid having for its first and principal seat the capillary layer.

The earliest change consists in the occurrence of minute collections of small round corpuscles like leucocytes immediately beneath the elastic lamina; the pigment epithelium adheres rather more firmly over these spots than elsewhere, probably because it early becomes mingled with inflammatory corpuscles which have either passed through the elastic lamina or been produced from the nuclei of the pigment cells themselves. (Plates I and II, and woodcuts Figs. 2 and 3.) There seems to be more tendency towards lateral extension of the cell growth in the chorio-capillaris than towards an invasion of the deeper layers, so that even in very severe cases the deepest layer, the lamina fusca, may remain tolerably free (Plate I). In this respect, and likewise in the absence of marked microscopical signs of degeneration, we find a great contrast with miliary tubercle of the choroid; miliary tubercles invariably begin in the deeper layers, and the centre of the growth soon passes into caseation. I have not succeeded in tracing all the steps between the stage of active exudation and of atrophy in syphilitic choroiditis, but

in the specimens from Case 7 abundant cell growth was still present, in some parts of the choroid which were nevertheless considerably thinner than natural, and in fig. 2, Plate III, some excess of nuclei is still present, even though the choroid is markedly thinned. It would probably not be true to say that epichoroidal effusion stands in direct relation to the amount of strictly intrachoroidal inflammation, for the ophthalmoscope shows that severe and extensive choroiditis often occurs and results in complete atrophy of this membrane without evidence of any effusion between it and the retina. Doubtless such epichoroidal effusions are sometimes quite absorbed, if we may judge by the changes in ophthalmoscopical appearances at different dates in the same case ; but there is certainly a marked tendency towards their organization into permanent fibrous tissue by which the retina and choroid are bound together, such fibrous tissue being shown by the ophthalmoscopical appearance of greyish-white patches, often with spur-like or linear processes, and bearing much resemblance in pattern to patches of keloid on the skin or of old false membrane on a serous surface. The illustration in Liebreich's Atlas, Plate V, fig. 1, shows a somewhat similar appearance in an early and curable stage, and Plate I. below, shows the microscopical appearances in such a case. Tough fibrous membrane closely investing the inner surface of the choroid is familiarly known as a consequence of severe choroiditis from other causes than syphilis, and furnishes the usual nidus for the formation of bone in the eye ; whether bone ever forms in the syphilitic membranes I am unable to say.

The *changes in the retina*, so far as my specimens show, agree fairly well with what the ophthalmoscopical appearances foreshadow. There is a general thickening of all the layers, but little tendency to the clumps of inflammation which characterise the choroiditis. The thickening is not, as in renal retinitis, due chiefly to œdema; nor do we, as in that disease, find hæmorrhages or lumps of amorphous or fatty material between the fibres of the connective framework. Although the thickening implicates all the layers,

it is, in my specimens, most marked in the nerve-fibre layer, where a great excess of stained corpuscles is found (Plate I and Plate IV, fig. 1). A similar increase of nuclei is found in the optic disc, on the inner surface of which the cells may even fill up the physiological pit and pass insensibly into the similarly changed hyaloid membrane. Well-defined collections of cells are, however, occasionally met with in the nerve-fibre layer, and one such is shown in woodcut Fig. 1. Very marked changes are seen in the arteries and minute blood-vessels of the retina, their coats being thickened and often crowded with small deeply-stained cells (Plates I and IV).* In the very late stage of a severe and widespread case the retina was thinned, some of its layers indistinguishable, and the blood-vessels, both small and large, ensheathed in pigment and their lumen often obliterated. Such retinitis pigmentosa, secondary to choroiditis, is a condition often found in eyes blind from chronic inflammation, due to other causes than syphilis.

The specimens described below throw but little light on the relation between syphilitic inflammation of the retina and of the choroid. They illustrate the law that whilst retinitis is usually widespread and diffuse, choroiditis is more often patchy and discrete. They also fit with the clinical experience that, although the ophthalmoscopical signs of syphilitic choroiditis and retinitis are very often found together, either may occur without the other; and that, when both retinitis and choroiditis are present, the choroidal deposits may sometimes be found only in some one part, such as the yellow spot region, being entirely absent near the disc, whilst, nevertheless, the disc and immediately adjacent retina may show marked changes (Case 5). Although we have been taught to believe, chiefly by Professor Förster, that the retinitis in syphilis is for the most part a consequence of the choroiditis, and, although no doubt there are many cases where this may very well be true, I think it cannot hold good of all. But neither does it seem possible to accept the

* See also Brailey and Edmunds, these Reports, vol. x, p. 137.

position so ably defended by Dr. Ole Bull,* that the reverse is the rule, the choroiditis being secondary to the retinitis. The mere fact that there are cases in which the only change is the presence of sharply-defined, punched-out patches of atrophy following syphilitic choroiditis, without the slightest ophthalmoscopical evidence of disease of the retina, is enough to prove that Bull's position cannot be universally true. Probably both doctrines are true; long-standing severe retinitis, whether syphilitic or, *e.g.*, due to Bright's disease, is apt to produce disturbance or absorption of the pigment epithelium, and thus to cause appearances which it is impossible to distinguish from those indicating a previous superficial choroiditis,—the result to the pigment epithelium being probably much the same in the two cases. The gradual appearance of such changes, producing changes like those due to primary choroiditis, but coming on in the course of a very chronic case where, for a long time, nothing whatever except diffuse haze of the retina could be made out, is well illustrated in the first of the two following cases; acute diffuse central retinitis with extreme defect of sight coinciding with an area of choroidal disease, strictly confined to a limited and far distant part of the fundus, is equally well shown in the second case.

Case 1. John Hanly, 31, an Irishman, was admitted at the South London Ophthalmic Hospital in December, 1877. He had had a chancre about six months before, and still had sores on the lips, tongue and palate. The sight had failed in both eyes for about two months, and was now very defective, especially at night. In both, the central region of the retina was uniformly very hazy, the haze being for the most part beneath the large vessels. No trace of choroiditis was visible anywhere. In the right there were some fine dust-like opacities in the vitreous, and one or two iritic adhesions; in the left the iris and the vitreous were healthy. He was a careless man and soon disappeared. In November, 1878, he was again under me, at St. Thomas's Hospital, as an in-patient, but would only stay a few days. The ophthalmoscopical appearances had not altered;

* Ole Bull, *loc. cit.*

he read 14 J. with the right and 13 J. with the left. I saw no more of him till February, 1882; he had had no treatment in the interval, and the sight had become worse (R. not $\frac{20}{200}$, L. $\frac{20}{70}$ and 8 J.). In the right there was not now much general haze, but a large whitish patch was seen, apparently beneath the retina, at the yellow spot; disc not pale, arteries of good size; the defect was presumably accounted for by the patch at the yellow spot. In the left there were some large, slowly floating opacities in the vitreous, much haze of retina about the disc and yellow spot, but no haze at the periphery, disc hazy and pale, arteries rather small; some small, much pigmented spots of choroidal disease thinly scattered about the yellow spot region and at the periphery. He still attends about once a year, and now (Summer, 1885) he can hardly see his way about. As he never would take medicine, his case affords a good instance of the unhindered progress of a bad syphilitic retinitis.

Case 2. Frederick Eldred, æt. 29, had a chancre in the early part of 1880, followed by an eruption on the forearms, ulceration of the tongue and falling of hair. About January 1st, 1881, a dimness began to come over his left eye "from the inner to the outer side; there was much flickering, blue mists, and coloured spots," but he did not notice any variations of sight. Dr. Gowers, under whose care he had been for old epilepsy, sent him to me three weeks after the failure began (January 18th). At this date with the left eye he could only see fingers moving, and best in the temporal part of the field. There were some pigment dots on the lens-capsule, a bee's-wing opacity deep in the vitreous, and diffuse retinitis. The retinitis caused a whitish haze over the whole central region, which was especially dense at a patch downwards and outwards from the disc; disc but little swollen, and not so hazy as the surrounding retina; veins and arteries all somewhat tortuous, and here and there partly obscured by haze. Right eye healthy. A month later, as he did not improve under out-patient treatment, I took him in for inunction. The ophthalmoscopical appearances were the same, and at the extreme outer part of the periphery I now found a large area of disturbed pigment epithelium, apparently indicating superficial choroiditis; no doubt this was present at the former

examination, though I did not see it. He was now put on mercurial inunction from February 7th to 10th, then, as there was no effect, on calomel and opium pill every four hours. Salivation began on 12th, when mercury was omitted; on the 14th he was freely salivated with diarrhœa and tenesmus; he could today count fingers with L. at one foot.—21st. Had an attack of temporary almost complete blindness in R.; sight came back perfectly in 10 minutes; nature of attack doubtful; a systolic murmur was heard at apex of heart. On the 24th L. made out letters of 20 J.—March 21st. L. reads 4 J. held close, but it looks much smaller than to the other eye; has been taking iodide of potassium nearly all the time, and during the last month a little mercury has been resumed; mercury now further increased. —March 24. Made an out-patient.—March 28th. Flickering complained of in L., so that he likes to close it.—April 14th. Still flickering and micropsia, V. 8 J. at 6″.—21st. 4 J. at 6″. —April 28th, V. 6 J. Latterly he had again many fits, though he was taking bromide, and as he was getting worse he was sent back to Dr. Gowers on May 12th. Careful ophthalmoscopical examination was made at that date; the vitreous was quite clear; optic disc and retina still slightly hazy; a few isolated black dots not far from the disc; peripheral area of choroidal disease unchanged.

Case 3 (with Plate III, fig. 3, and Plate IV, figs. 1, 2, and 3). Mary Ann B., æt. 40, single, of small stature, subject to chronic rheumatism, was an in-patient in St. Thomas's Hospital from February 11th to June 5th, 1879, for obstinate plastic iritis of both eyes. The notes of the case (I. P. Book, p. 191, and Path. Book, No. 147) are not very full, as the woman was dull, and gave but a meagre account of her symptoms. She had, however, on admission an eruption of dusky, circinate spots on the back of the neck, and said that she had lately had a sore throat lasting for a month; she complained of general weakness and pains in different parts of the body. I had no doubt whatever at the time that she was suffering from secondary syphilis.

On admission there was iritis in each eye, with many adhesions, T. n., V. less than $\frac{20}{200}$, dull reflex from fundus, but no

details visible. Half a drachm of strong mercurial ointment was rubbed in daily for a few days, when, as she was salivated, it was stopped. Mercury was resumed by the mouth soon after, and was continued till her discharge. Three weeks after admission the L. eye counted fingers at 6′, the disc was visible, but seen through a haze; the R. had only p.l. Later, March 31st, the R. was beginning to soften, and although the eye was neither congested nor tender, she was complaining of neuralgic pain passing from the right eye across the forehead. There is no note for the next six weeks. Then, on May 15th, it was noted that she "still has attacks of severe pain, chiefly in R. side of the head, in connexion with brief attacks, often lasting only a few hours, of redness and tenderness of the R. eye." At this date, in the R. eye, there was ciliary congestion, dulness of aqueous and no p.l., but T. was n.; the corresponding side of the scalp was tender and sore. As the eye had remained troublesome for so long, in spite of mercury, atropine and leeches, and was quite useless, I removed it on May 16th.

The eye was opened by an equatorial section at once. The vitreous, detached from the hinder part of the eye, was shrunken to less than a half of its full size—was too firm, slightly hazy, and streaked with denser opacities. Examined whilst fresh, it was found crowded with corpuscles of various shapes and sizes, some being round, others tailed and continued into long branching processes. A few of these cells were quite fatty. There were no blood-corpuscles. There were none of the large mother-cells containing numerous corpuscles which are sometimes seen in specimens of inflamed vitreous. The clear colourless fluid between retina and detached vitreous was not further examined. The whole retina showed a slight milky haziness, and, in addition, there were three spots of much denser haze, from whose borders spur-like, apparently puckered processes were given off resembling in a minor degree Fig. 1, Plate X, in Liebreich's Atlas. Two or three of these patches lay exactly over round spots of white choroiditis; two or three other spots of choroiditis were present, but not obscured by patches of retinal haze; several white spots were also seen on the pars plana of the ciliary body; disc very hazy, but not obviously swollen. After hardening, sections were made of the retina and choroid: but although the spots of choroiditis were easily found, the

patches of retinal opacity could not be definitely made out. In the choroid a moderate number of small growths, consisting of pus-like cells, are found in the chorio-capillaris; sometimes the elastic lamina is raised up over them, but usually not. In some places precisely similar cells lie over the growth on the inner (retinal) surface of the elastic lamina. The cells in the choroidal deposits are usually just like the white blood-corpuscles in the adjacent vessels, but some are larger and oval. In some sections there is a more diffused cell-growth, but in no part is the choroid decidedly thickened, nor are its vessels much distended. Retina thickened throughout, bacillary layer degenerated, great increase of nuclei in the nerve-fibre layer (Plate IV, fig. 1), very marked increase of nuclei in the coats of the small blood-vessels (Plate IV, figs. 2 and 3). The aqueous humour in the hardened specimen coagulated into a soft jelly. The iris, besides diffuse cell-infiltration, shows a well-marked cell-clump close to its pupillary border between the sphincter muscle and the anterior surface (small gumma); this cell-growth is well shown in Plate III, fig. 3, *g*; it does not occasion any localised swelling.

Case 4. (With Plates I and II, and Plate III, figs. 1 and 2.) Charles T. was under the care of Mr. Brudenell Carter, at the South London Ophthalmic Hospital, for interstitial keratitis with iritis, from March, 1876, to January, 1877; the iritis was severe, leading to closure of pupils. The disease had begun some months before his admission. In January, 1877, when there was still much corneal haze, the left eye was ruptured by a poke from an umbrella-stick, and ten days' later was excised by Mr. McHardy for Mr. Carter, and kindly handed to me (Path. Book, No. 92). There was a large rupture, or lacerated wound, occupying the upper and inner part of the marginal region, involving both the sclerotic and the cornea. The wound had closed and was slightly puckered, but not inflamed, and the globe was very soft. On opening the fresh specimen the vitreous was found blood-stained and fluid, and a blood-stained mass was situated on the ciliary body near the wound; lens absent; no other changes attributable to the accident. Tunics *in situ;* a tract of pigmented choroidal disease near the equator, the retina over this part being adherent, and showing patchy opacity. The choroid

and retina, with this exception, looked healthy to the naked eye. The cornea was hazy, especially at its lower part.

After hardening in equal parts of spirit and Müller's fluid, sections were made of the cornea and ciliary region opposite to the rupture, of the disc and surrounding parts, and of the choroid and retina at the diseased area.

The cornea was considerably thickened, and contained many vessels at various depths; many of these, entering the deep corneal layers from the sclerotic, came nearer to the anterior surface as they approached the centre of the cornea; a well-marked, muscular coat was visible in some of the vessels. Small cells like white corpuscles were scattered throughout the cornea, especially around and near to the blood-vessels; they seemed to lie between the corneal corpuscles, the latter bodies themselves being flat and unaltered. The epithelium of Descemet's membrane normal; Bowman's membrane hardly appreciable. There is a layer of thickly nucleated tissue (episcleritis) on the sclerotic in the ciliary region, but it gradually thins off posteriorly; the veins in this layer are enormously distended. There is increase of nuclei in the deepest layer of the sclerotic at the attachment of the ciliary muscle and Descemet's membrane (true deep scleritis). The immediately contiguous part of the ciliary body, just around the *circulus arteriosus major*, shows a dense aggregation of nuclei; the ciliary muscle itself is infiltrated with cells, but shows no circumscribed collections; very little, if any, change in the ciliary processes.

The above changes are partly attributable to the old keratitis, partly, no doubt, to the injury.

The anterior part of the choroid shows changes which are certainly older (Plate I); the whole choroid here is thickened and its veins immensely distended, and it shows several centres of intense nucleation; the pigment of the choroid proper is not increased; the epithelial pigment is irregular, in some places absent or scattered, in other parts heaped up, and apparently increased in quantity; the retina is adherent to the choroid at many spots by fibrous tissue, which seems to have grown through gaps in the elastic lamina of the choroid, and have then made its way in a horizontal plane between the two tunics; the corrugated elastic lamina is easily traceable beneath much of this epichoroidal growth, but in places it is invisible

for considerable distances. The retinal layers in this part are much altered and the whole retina thickened; the bacillary layer is absent at the adherent spots. The parts just described correspond with the tract of pigmented choroidal disease with adherent retina above-mentioned, near the equator.

In other parts of the choroid, foci of growth composed of small pus-like corpuscles, with minute, often multiple, nucleoli, are found; these are minute gummata. When very small these cell growths almost always lie in the chorio-capillaris (Plate II, figs. 1 and 2). Sometimes a mass of cells in the chorio-capillaris is continuous with a similar collection on the inner surface of the elastic lamina, through which the cells appear to have passed (Plate II, Fig. 2), causing disturbance of the pigment epithelium; one gumma shows commencing degeneration at its centre (Plate III, fig. 1). These choroidal growths differ from tubercle by their small size, the absence of giant cells and of reticulum, and the want of any relation to the choroidal arteries; the gross choroidal disease described near the equator (Plate I.) no doubt resulted from the confluence of numerous gummata.

One section traverses a patch of atrophied choroid which looked pale to the naked eye. The choroid in this patch is much thinner than elsewhere (Pate III, fig. 2), and the capillary vessels have almost disappeared; but it still shows a slight excess of nuclei; the deep pigment is unaltered; the epithelial layer was lost in making the section.

There is general thickening of all the layers of the retina in all parts, and of the optic disc, due partly to œdema, partly to increase of connective tissue. Müller's fibres are elongated, and in parts separated by spaces, and their nuclei near the limitans interna are increased so as to form a distinct layer. The retinal arteries are much thickened and hyaline-looking, and around the vessels in and near the disc there is marked increase of nuclei. It is difficult to find any muscular coat to the arteries, and they are distinguished from the veins chiefly by the greater thickness of their walls. The growth causing this increased thickness is not, however, in the muscular coat, nor in the intima, but in the adventitia, and consists of small round cells much more deeply stained than the muscle nuclei, and distinguished from the leucocytes in the vessel, by the latter being always

segmented into three or four parts. There is sometimes a space between the muscular coat and the thickened adventitia (perivascular space). These changes are certainly most marked in connexion with the arteries; no well-marked alterations are seen about the veins, though in some sections vessels (? veins) are seen with general fibrous thickening of their inner coats, without marked increase of the nuclei of the adventitia. There is a similar change in some of the choroidal arteries. The ganglion cells are quite normal. There is well-marked inflammation of the hyaloid in the physiological pit. The choroid shows hardly any change near to the disc, except one or two small centres close to the border of the disc in the chorio-capillaris, with epichoroidal growth upon them by which adhesions are formed with the retina; at the apex of one of these growths the lamina elastica is wanting, whilst in a section nearer its base this membrane is traceable over the whole growth.

There is much inflammatory change, partly old, partly new, on the flat part of the ciliary body.

The cells or corpuscles found generally throughout the cornea, episclera, sclera, ciliary muscle, and the choroid and retina, are of pus-like size and appearance. In certain parts, however, cells of quite different aspect are found. These are of much larger size, round or oval, and much more intensely stained by logwood than the small cells. They are found scattered, either singly or in considerable numbers, in the episcleral tissue, along some of the perforating scleral vessels, throughout the whole thickness of the ciliary muscle and the layer of connective tissue between the muscle and its epithelial pigment. They are absent from the cornea, membrana supra-choroidea, choroid and retina, including the "ciliary retina." Probably these large, deeply-staining cells are related to the traumatic inflammation, and not to the syphilitic disease, from which this eyeball suffered.

Reference may also be permitted to the following specimens, accounts of which have been already published, and which I have again carefully examined for the present paper.

Case 5. John H., aged 15 months; case published by Dr. Barlow, in the Transactions of the Pathological Society, vol. xxviii, p. 291 (Path. Book, No. 93), with the following heading: "Gummata on Cranial Nerves; Disease of Cerebral Arteries; Cicatrices of Liver and Spleen, in a case of Congenital Syphilis." Dr. Barlow had examined with the ophthalmoscope and found no changes. I examined the back of one eyeball, and reported to Dr. Barlow that I could find no definite changes. This statement I regret, as a more careful examination of the same sections has since shown at least one definite, limited exudation of small cells in the inner part of the choroid. There is also considerable thickening of the retina near the disc (the sections do not extend far from this part), a very well defined circular mass of small cells, like those in the choroid, in the nerve-fibre layer (Fig. 1), and marked thickening of the coats of several retinal arteries with increase of their nuclei. The retina is not well enough preserved to admit of any more precise description.

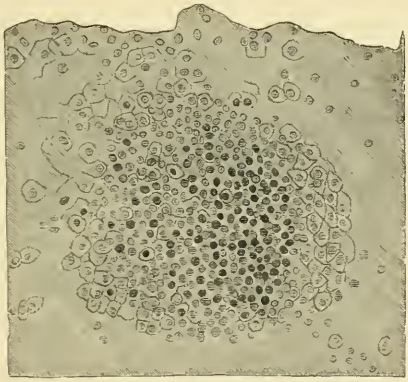


Fig. 1.—Collection of cells (small gumma) in the nerve-fibre layer of the retina. The upper boundary is the inner limiting membrane. × 220.

Case 6. Elizabeth W., also Dr. Barlow's patient, and published in the Pathological Society's Transactions, vol. xxviii, p. 287 (Path. Book, No. 27). The case is headed "Meningitis, Arteritis, and Choroiditis in a Child, the subject of Congenital Syphilis." At the age of about 9 months Dr. Barlow found

with the ophthalmoscope the following appearances: "Sparingly distributed very small flecks of exudation of brownish colour, apparently situated in the choroid. There was scarcely any disturbance of pigment, and no atrophy. So far as I could judge, there was no alteration in the optic discs. At that time I had never seen anything quite like it except once, in a young man who was the subject of acquired syphilis, and who was suffering from an attack of recent hemiplegia, probably the result of syphilitic thrombosis. I have since seen one case identical in appearance in a child, the subject of congenital syphilis with nervous symptoms, and in whom I have traced some of the spots on to the atrophied condition with which one is familiar in choroiditis disseminata. It cannot be too strongly stated that the ophthalmoscopic appearances in E. W. were as different as possible from the milk-white, round, larger defined spots which are recognised as tubercle of the choroid."

The child died within a month from the above examination, and I made sections of the choroid in the yellow spot region where the above spots of disease had been chiefly seen, and where they were visible after removal of the retina as minute round whitish dots, and also of the disc and neighbouring retina.

The following description was given together with the accompanying woodcut (Fig. 2), which I am allowed to reproduce:—"The changes in the choroid consist in the presence of small collections of corpuscles in the chorio-capillaris. Sections of several of these were found in the part of the choroid which had shown during life little flecks of exudation, and none were found elsewhere.

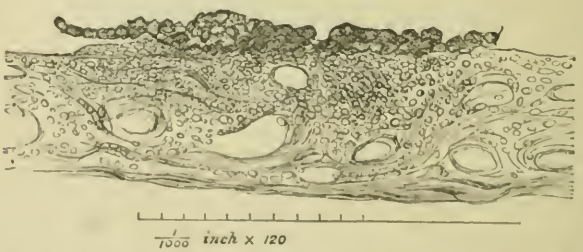


FIG. 2.—Small gumma in capillary layer of choroid (from Dr. Barlow's case, Path. Soc. Trans., xxviii, 287).

"The corpuscles are about as large as pus corpuscles and stain deeply with logwood. They stand in no evident relation to the blood-vessels, and none of them occur in the deeper part of the choroid. In all these particlars they differ from tubercle.

"The elastic lamina over these deposits is slightly raised, and sometimes a little puckered. In several instances at the seat of the deposits a thin layer of flattish cells is present on its inner (retinal) surface, immediately beneath the pigment epithelium, but in no sections could any perforation of the lamina be detected. The epithelium itself appears morbidly adherent."

The choroidal changes are better shown in the new woodcut (Fig. 3), which I now add.

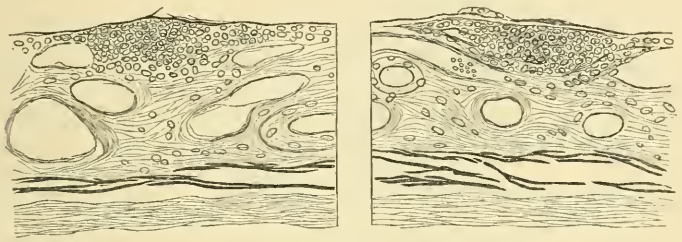


FIG. 3.—Two other minute gummata in the capillary layer of the choroid from the same eye as Fig. 2. Pigment epithelium lost; flat cells lying on elastic lamina in one specimen, elastic lamina split or frayed out over the growth in other specimen. × 120.

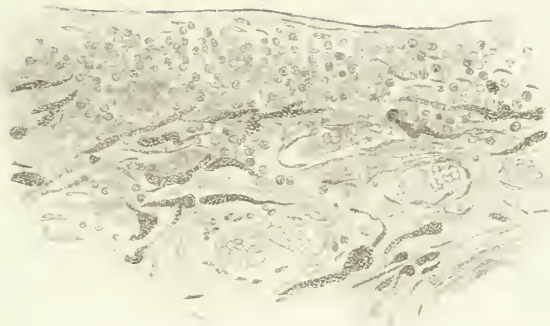
Dr. Ole Bull,* in commenting on this case, observes that the state of the retina was not described. I have no sections of the retina except near to the disc. The disc itself is slightly swollen, but the swelling extends only a very short distance into the retina. The physiological pit is filled up by an irregular collection of small lymphoid cells, which spread in the form of a thin layer, a little way on each side; there is also a great excess of nuclei in the disc itself, as far down as the level of the lamina cribrosa; but further back, although the arachnoid sheath is thickened, the nerve itself seems tolerably healthy (the sections extend one-eighth of an inch beyond the eyeball). Many of the arteries in and close to the disc show

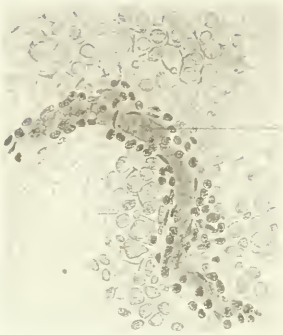
* Bull, *loc. cit.*, p. 91.

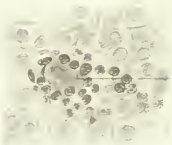
very thick coats. It is particularly to be noted that there were no spots of choroiditis near the disc in any of the sections.

In this case it can hardly be doubted that the changes in the choroid were co-incident with, or at least not subsequent to, those in the disc and adjacent retina; for the cells in all parts had the same characters, no signs either of degeneration or atrophy were present, and the child was too young for the morbid changes in different parts to have been separated by any long interval of time.

Case 7 has been previously published in these Reports, vol. vii, p. 374 (Register No. 78). The eye, which was excised from a woman aged 25, had begun to atrophy, and the retina was detached and shrunken; the eye had been inflamed for a year and a half during secondary syphilis. A re-examination of the sections of choroid, which have kept well for fourteen years, shows alterations like those in the other cases, but, as might be expected, with commencing atrophy. Collections of small cells, sometimes circumscribed, in other parts more widely spread, are present in the chorio-capillaris. The elastic lamina is thickened and sometimes wrinkled, and numerous small "colloid" growths project from its retinal surface. In some places the thickness of the whole choroid is a good deal reduced, and here, as a rule, there are no collections of corpuscles. Dr. H. Pagenstecher made drawings from other sections of this choroid, and I believe that figs. 1, 2, and 3 in Plate XIV of his Atlas are taken from them, although Dr. Pagenstecher's description of the eye from which these drawings were made does not quite tally with the case as published by myself.







DESCRIPTION OF PLATES I, II, III, AND IV, ILLUSTRATING MR. NETTLESHIP'S PAPER ON SYPHILITIC CHOROIDITIS AND RETINITIS.

Plate I shows, under a low power, the appearances of a vertical section through a patch of severe choroido-retinitis, with inflammatory adhesions between choroid and retina. There is great thickening of the coats of a large retinal artery seen in section at the lower part of the figure. In Case 4. × 70.

Plate II, figs. 1 and 2 show collections of small round cells in the capillary layer of the choroid (microscopic gummata), from the same eye as Plate I.

In Fig. 1 the elastic lamina of the choroid passes intact over the seat of the cell-exudation; the pigmented epithelium has been washed off. (From a section mounted in Dammar.) × 220.

Fig. 2 shows a larger collection of cells, many of which have passed through the elastic lamina causing disturbance, and even complete disappearance, of the pigmented epithelium. The elastic lamina appears to be almost destroyed at this part. (From a section mounted in Glycerine.) × 220.

Plate III, figs. 1 and 2 are from the same eye as Plates I and II.

Fig. 1.—Section of a rather larger gumma occupying the middle and innermost layers of the choroid; centre beginning to degenerate; pigmented epithelium unaltered. × 70.

Fig. 2.—Section through a small patch of partially atrophied choroid. A slight excess of nuclei is noticeable in the atrophic part. Pigmented epithelium was probably disturbed or partly absorbed, but its remains have been washed off in the process of mounting. × 70.

Fig. 3.—From a vertical radial section of the iris at its pupillary border. Uveal surface uppermost. *s*, fibres of sphincter muscle cut rather obliquely. *g*, effusion of small cells between the sphincter and the anterior surface. If larger, this cell-mass would form a "nodule" or "gumma" on the iris. From Case 3. × 30.

Plate IV shows the changes in the Retina in Case 3.

Fig. 1 shows general thickening of retina with increase of nuclei, and œdema. The cell increase is however most marked in the nerve-fibre layer and inner granular layer. The hyaloid membrane also shows increase of nuclei.

The coats of all the small blood-vessels are crowded with nuclei, which are smaller but more deeply stained than the surrounding nuclei.

Figs. 2 and 3 show, under a power of 220 diameters, the vessels *a* and *b* which are displayed under a lower power (70 diameters) in Fig. 1.

THE MORE MODERN OPERATIONS FOR TRICHIASIS.

By Arthur H. Benson, F.R.C.S.I.,

Ophthalmic Surgeon to City of Dublin Hospital, Assistant Surgeon to Saint Mark's Ophthalmic Hospital.

Operations for the cure of Trichiasis are as the stars of heaven for multitude; but I shall confine my remarks to three of the more modern and most generally applicable.

Cases of Trichiasis, with or without Entropium, have until lately been amongst the most hopeless, regarded from a surgical point of view. In most instances the older operations aimed at either removing the offending hairs, and with them a larger or smaller amount of the lid substance, or effecting the alteration in the direction of the cilia by everting the lid border. They were for the most part associated with shortening of the lids, and almost certainly permitted a recurrence, except in the radical but barbarous operation of abscission of the lid border. Since Mr. Spencer Watson gave birth to the idea of preserving and transplanting the strip of skin, thrown away in Arlt-Jäsche's operation, every modification has been in the conservative direction, and has produced more satisfactory results.

Those who wish to obtain a full and historical *résumé* of the subject can do so by consulting the admirable paper written by my friend and colleague, Dr. Story, in the "Ophthalmic Review," vol. ii, p. 37.

Partial Trichiasis has long troubled ophthalmologists, especially that form of it so often met with, where, without Entropium, one, two, three, or more cilia are growing in a faulty direction, rubbing on the cornea, and causing the utmost annoyance.

At the meeting of the British Medical Association, held in August and September, 1882, I read a paper on the use of

Electrolysis in this form of the affection.* As I have since then largely increased my experience of the method, which was at that time quite a new one, I may be forgiven for recapitulating some of the statements I then made in ignorance of the fact that Dr. Michell, of Missouri, had been working in the same direction and with similar results.†

The operation is done with a constant current battery: I use ten small Leclanché's cells. A fine electrolysis needle is attached to the *negative* pole, and a large pad to the positive pole. The needle is then passed along the hair to be destroyed until its point reaches quite up to the extremity of the bulb; contact is then made and the circuit completed by applying the pad to the temple or brow. The electrolytic action of the current decomposing the watery elements of the tissues produces a bubbling of hydrogen gas around the needle, and a slough forms in a few seconds. When the ring formed around the cilium and needle is of sufficient size to insure the destruction of the bulb, that is, in about 20 seconds, if the battery is working well, the needle is removed, and the hair caught in a pair of forceps and drawn out, or wiped away with the slough. If the hair does not easily and without the least drag come out and bring with it a mass of greyish, gelatinous slough, it is better to reapply the needle, as unless the bulb is fully destroyed, the hair may grow again.

Each hair must be so treated, unless two or more grow so closely together that they can be simultaneously destroyed, but it is better not to make the slough larger than necessary, and therefore it is preferable to attack each hair separately.

The operation is very painful, but the pain ceases at once on removal of the needle, and no inflammatory reaction or subsequent contraction follows.‡

* Brit. Med. Journ., 16th Dec., 1882. † Klin. Monatsbl., April, 1882.

‡ The use of an anæsthetic, though not in most cases necessary, will be found to simplify the operation very much.

I have now performed this operation on many hundreds of cilia, and have every reason to be pleased with the results.

The advantages of this mode of treatment are so obvious that it seems hardly necessary to state them, but as many of the text-books still continue to recommend epilation, actual or potential cautery, and excision, it seems that the method is either unknown or unappreciated as it deserves. By this method you—

(1.) Can destroy with certainty, and without disfigurement of the lid, any number of individual aberrant cilia, no matter how attenuated or how short they may be.

(2.) There is no need for hurry in applying the needle, but the hair to be treated may be selected and the needle inserted with the utmost deliberation, as no action takes place until the second pole is placed in contact with the skin. (How different when using the actual cautery.)

(3.) The effect can be gauged with perfect accuracy, for if, after removing the needle, it be found on trial that the cilium is still firm, the needle can be again applied, and so on until the required effect has been produced. Practically, however, this is seldom necessary, for a little experience enables the surgeon to judge by the appearance of the slough how soon to remove the needle. (How different again is this from the cauteries: where once applied their action is almost beyond control, and if the actual cautery be used the external portion of the hair is burned so that the guide is lost.)

Epilation and Illaqueatio are the only operations which can in any way compare with electrolysis. The former is, however, only palliative, and by the irritation of its frequent repetition may often cause the growth of fresh hairs without destroying those removed. From its simplicity, however, it will always be practised in certain cases.

Illaqueatio from its antiquity is worthy of all respect, but, setting aside the fact of its being only applicable to

those cases where the cilia are long and strong, I have every reason to believe that in few instances are its results permanent, and I see no advantage which it possesses over electrolysis, for the advantage of preserving abnormal cilia is purely theoretical, and not sound even from that aspect. The cilia which cause trouble in Trichiasis are not, as some writers seem to think, the normal hairs in an abnormal position, but in a very large majority of cases they are new-born hairs produced by reason of the hyperæmic condition of the original bulbs. The increased nutrition causes the hair-follicle to send off buds which develop fresh hairs, and it is these that are the source of annoyance. The original rows of cilia retain their normal and innocuous position: why then is it better to snare these errant hairs and try to make them grow out through the skin (an entirely abnormal position) rather than destroy them entirely? Clearly it is not better.

For cases of *extensive Trichiasis*, with or without Entropium, Dianoux's operation was, until lately, the most satisfactory of the modifications suggested by Spencer Watson's method. It consists in splitting the lid, as in Arlt-Jäsche's operation, then making two incisions in the skin of the lid parallel to the lid border, the one nearest the cilia being made sufficiently deep to join the intermarginal incision, the second only extending through the skin of the lid. The upper (skin) flap is then drawn down underneath the ciliary flap and made fast with a suture at each end, whilst the ciliary flap is stitched up in the position vacated by the skin-flap. The effect is that the cilia are elevated by as much as the breadth of the flap, and receive a firm and permanent support from below by reason of the transplanted skin. This operation I performed in a large number of cases, sometimes with the most satisfactory results; at other times without material benefit to the patient, although, surgically considered, the operations were entirely successful. The reason of this difference was not far to seek.

When the hairs rubbed on the cornea because the lids were inverted, and where the cilia were growing in their normal position relatively to the lid border, then the double transplantation operation gave good results, for in this case the transplanted skin flap and the cicatrices were all on the free border of the lid, and did not rub on the cornea. But where, owing to the existence of true Trichiasis, the abnormally situated cilia grew so close to the conjunctival border of the lid that, in order to ensure having them all in the anterior plate, the intermarginal incision had to be made very close to or in the conjunctiva, then the skin flap had to be transplanted into a situation where contact with the cornea was inevitable, and consequently irritation, due to the presence of the downy hairs of the skin, was also inevitable. Thus the operation, though affording considerable relief, did not satisfy the requirements.

I may here mention that my observations of the behaviour of the skin flap transplanted to the conjunctival border of the lid, are at variance with those of most other writers. They state that no irritation is produced by the skin rubbing on the cornea, and affirm that in a very few weeks it is difficult to distinguish the flap from the mucous membrane beside it. I have under observation still several cases operated upon from one to two years ago, and in all it is still quite easy to see the limits of the skin flap, more especially as the epithelium continues to form in white, easily removed masses, and there seems to be no appreciable change in the appearances for many months.

Again, Mr. Swanzy in his Handbook of Diseases of the Eye, p. 141, says: "The wounded surface of the ciliary flap amalgamates with the epidermic surface of the skin flap so completely, that in the course of a short time it is impossible to separate them, and ultimately nearly all traces of the operation disappear." In my experience this union never takes place. I have always, even after an interval in some cases of two years, been able to pass a fine probe through the lid from skin surface to lid

border. This, however, produces no deformity of the lid and the cosmetic result of the operation is most excellent.

In view of the imperfections of Dianoux's method, Van Millingen, of Constantinople, suggested the transplantation of a strip of mucous membrane taken from the inside of the lip. Van Millingen in his earlier operations used conjunctiva from the rabbit. Subsequently both he and Mr. Story, of Dublin, quite independently of one another, adopted the plan of taking mucous membrane from the lip.

The *method of performing this operation*, which I have found most useful, is as follows.

The lid border is split as in all this class of operations, care being taken that all the cilia are in the anterior plate, and that the section is made to extend well up to the roots of the cilia, or above them. The clamp is then removed from the eyelid, and the bleeding allowed to stop, whilst the same clamp, or by preference a larger one, is applied to the everted lower lip of the patient and screwed down.

Two parallel incisions of the required length are then made through the mucous membrane about 3 or 4 mm. apart, and the flap dissected up. This is best done by passing a strabismus hook under the flap at one end and dissecting up towards the centre, then doing the same at the other end; by this means the flap is not bruised, as the use of forceps is entirely avoided; it is more easily dissected, being left attached to the lip at both ends and in the middle, and its nutrient supply is only cut off for the minimum time.* The central adhesion being divided, a threaded needle is passed through one end of the flap (still adherent to the lip at both ends), and inserted into

* A method of dissecting the flap which I have found very useful is that by multiple transfixion. It is done by passing a curved broad needle under the flap in a number of places, so as, to a large extent, to separate the mucous from the sub-mucous tissue of the lip, then through one of these transfixion holes introduce the strabismus hook and divide the intervening bridges of tissue as above.

the angle of the gaping intermarginal cut. A second needle is passed through the other end of the flap and through the corresponding end of the lid wound. One end of the flap is then divided with scissors, and, holding the flap on the stretch by the suture passed through it, all fat and sub-mucous tissue is carefully removed with curved scissors. This is an important step of the operation. The other end of the flap is then divided with scissors, and the band of mucous membrane is lifted up to position in the lid, and the sutures made fast. A central suture is then inserted, iodoform ointment on lint is applied over the lid, and a pad of wool and a bandage complete the operation. No sutures or dressings are applied to the lip, which heals with great rapidity.

The operation is necessarily a tedious one, but not more so than Dianoux's, nor is it more difficult. At first considerable annoyance was experienced from the bleeding of the lip when held everted by an assistant; the clamp, however, obviates that, and moreover saves the assistant from a most tiresome job, as will readily be granted by any one who has tried to keep a slimy lower lip everted and on the stretch during the slow dissection of the flap. Moreover, the assistant's two hands are much more in the way of the operator than the clamp is.

The depth of the intermarginal incision is a matter of great importance. It should be deep enough to permit the strip of mucous membrane, when transplanted, to lie smoothly, and in complete contact, on the raw surfaces; not as forming the base of a triangle whose apex is at the superior angle of the wound (in upper lid).

The introduction of the sutures whilst the flap is *in situ* is, I think, an advantage in that it saves much of that dragging which often injures the vitality of flaps, and it shortens the time of total separation. I have usually found a curved broad needle the most convenient instrument with which to complete the dissection of the flap.

This operation, or something like it, I have performed

about 15 or 20 times, and assisted at as many more. I have done it with the most satisfactory results on both upper and lower lids, and without a single total failure. Usually the whole flap lives, at times a small portion sloughs, but when it does I generally find that it was too long for its bed, or was in some way thrown out of position.

In the first case on which I operated, I cut the flap too long, allowing too much for shrinkage; in this case the flap lived at each suture, but sloughed between them, pointing to the fact that close application is essential.

The surgical results, then, of this operation are quite as good as those of Dianoux's, and the advantages of transplanting mucous membrane instead of skin, to the lid border or conjunctiva, are so obvious that even if it were far less of a success surgically, it would still be preferable to any other operation that has as yet been suggested for the cure of extensive Trichiasis.

It is too short a time (only a few months) since the operations have been done to judge of their ultimate results, but so far the effects have been uniformly excellent.

CURATOR'S PATHOLOGICAL REPORT.

By W. J. Milles, F.R.C.S.,

Late Curator of the Hospital Museum.

Part I.—*Detachment of the Vitreous Body.*

In the subjoined table will be found a short report of 43 cases of detachment of the Vitreous Body from the Retina. These cases occurred out of a series of 345 eyes removed at Moorfields Hospital. In every instance the retina and choroid were in their normal position, or only very slightly detached. I have excluded all those forms of wide detachment of the Retina, with shrinking of the vitreous, and limited myself solely to separation of the vitreous body from the retina.

Detachment of the vitreous body may be roughly divided into two forms, the *infundibular*, and the *globular;* the latter, I believe, being a late stage of the former.

The *infundibular*, in my experience, is the more common form, and commences by a separation of the vitreous body from the retina, usually in the equator of the globe or just behind the equator. As the vitreous shrinks, the separation becomes wider, till the outline resembles that of an umbrella detachment of the retina: the vitreous remains adherent at the papilla by a more or less delicate attachment. This attachment is sometimes so fine, that it breaks away at the slightest touch; sometimes it is very firm and fibrous, a solid cicatricial cord filling up and completely obscuring the optic disc. The vitreous is again firmly fixed to the ora serrata and pars ciliaris retinæ; it is usually closely in contact with the posterior surface of the lens, and I have been unable to detect the wide separation in this position described by some authors.

In one or two instances the vitreous was fluid in the centre, and so consisted simply of a funnel-shaped mass, which was excessively tough and firm.

A few of my cases indicate a stage prior to the infundibular detachment: there is a fairly broad basis of attachment behind reaching a few millimetres on all sides of the papilla.

The *globular* form of detachment has no attachment behind, and is evidently a late stage of the infundibular; for on careful examination I usually found a small tag hanging from the posterior part of the vitreous. The infundibular can frequently be made into a globular detachment by simply detaching the vitreous at the papilla.

The *hyaloid membrane* in some cases is separated with the vitreous from the retina, though in the majority it remains with the latter. However, when it does remain with the retina, it can be separated from it with the greatest ease by a pair of forceps. Now and then I have noticed, when the vitreous has been widely separated, that the hyaloid membrane has been floating loose in the fluid between the vitreous and the retina. I think it is certain that the membrane which is called the hyaloid is part of the vitreous, for from a pathological point of view it seems always to be affected when the vitreous is diseased: notably in cases of fluid vitreous, the hyaloid membrane is almost always separated from the retina. Comparative anatomy shows that it is developed with the vitreous, for it passes over the Pecten in birds, a position where there is no retina.

I have grouped the cases as follows:—

		No.
Table I.	Penetrating wounds	15
	Blows	5
,, II.	Ulcers perforating	2
	,, non-perforating	5
,, III.	Glaucoma	8
,, IV.	Sympathetic ophthalmitis	3
,, V.	Extraction of cataract	3
	Needling operations	1
,, VI.	Recurrent iritis	1
	Total	43

It is noticeable in Table I. that the tension of the eyes at the date of excision was with one exception diminished; also that in all the 20 cases in this table there was suppurative hyalitis more or less advanced. From the history of these cases, and from the extent of the external wound of the eyes, it is probable that in nearly one half of them there was more or less loss of vitreous at the time of the accident; so that they do not bear so much on idiopathic detachment of the vitreous.

In Table II. the tension was normal in 3 cases, subnormal in 2; there was suppurative hyalitis in 3 instances.

In the group of Glaucoma cases, the tension was invariably increased at the time of excision. Suppurative hyalitis was present twice.

In Table IV. 2 eyes were exciting, 1 sympathising, tension being increased in 2, and diminished in 1.

In the eyes excised after extraction of cataract the tension was increased in 1, and diminished in 2; suppurative hyalitis was present in the latter.

Microscopic examination of the vitreous showed in most instances a large increase of cells. Of course this was to be expected in the forms of suppurative hyalitis. Here there was proliferation of the normal vitreous cells, seen chiefly in the centre, with a large number of smaller migrated inflammatory cells in the periphery, chiefly in the region of the ciliary body. In one case, the pus cells (at some distance from the margin of the vitreous) contained pigment granules evidently taken up from the broken up pigmentary layer of the pars ciliaris retinæ. In one case of great fibroid thickening of the vitreous, there were a large number of vitreous cells of various shape and size. No detailed microscopic examination of the eyes is given in the tables, as it would be rather beyond the scope of this paper.

The method I have employed in examining these eyes, was the ordinary one of leaving them for a period varying between one month and six weeks in Müller's fluid, then

opening them in an antero-posterior direction after they were frozen, making the section just to one side of the papilla. A careful note was then taken of the position and size of the vitreous, as the specimen lay in water. It might be objected that the Müller's fluid may have produced some shrinkage of the vitreous body during the process of hardening. That no alteration whatever occurs I feel almost sure: for I have found that no diminution in the size of the vitreous happens in healthy eyes as well as in a large majority of diseased ones, otherwise all eyes examined by this method would have detached vitreous. To make assurance doubly sure, a certain percentage were examined in the fresh state, among which were some few cases of detachment. The examination in a fresh state is however rather unsatisfactory, as the parts are so liable to become collapsed.

The practical conclusion to be drawn from these cases is, that if there is diminished tension in an eye with a punctured wound there is every probability that the vitreous is suppurating and detached, other signs of inflammation, &c., being present.

Reduced tension, however, does not necessarily mean detached and shrinking vitreous, nor on the other hand does increased tension exclude it, for in eight cases of glaucoma, with increased tension at the time of excision, a detached vitreous was found.

TABLE I.—*Eyes Lost by Injury.*

Sex, age, and register No.	Nature of accident, with account of chief pathological changes in excised eye.	Interval between injury and excision.	Tension at date of excision.	Pathological changes in vitreous body.
Female, æt. 58. No. 1043.	Blow on right eye with a piece of wood: lacerated wound of cornea: part of iris torn away; lens *in situ*.	5 weeks.	T 1.	Infundibular detachment well marked: streaks of lymph passing backwards from lowest part of ciliary body.
Female, æt. 9. No. 1046.	Punctured wound of left cornea, iris, and lens. Puckering of cornea: iris inflamed: puncture passes through lens and into the vitreous: lens greater part absorbed.	6 weeks.	−T 1.	Infundibular detachment not so extensive as last case; its posterior surface is streaked with blood. *Suppurative Hyalitis.*
Male, æt. 18. No. 1055.	Blow on right eye 7 years ago. Iridectomy performed then: pain last 2 months. Anterior synechiæ: absorption of lens: nodule of lymph on ciliary processes. Retina and choroid *in situ*. Papilla swollen with a tag of lymph attached to it.	7 years.	T.n.	Globular detachment evidently infundibular at one time from tag of lymph attached to papilla. Numerous small punctate foci of inflammation scattered all over vitreous.
Male, æt. 40. No. 1060.	Left eye struck by piece of steel. Electro-magnet used. Wound of entrance in cornea, wound of exit close to papilla: iris adherent at corneal wound: lens absorbed.	1 month.	−T 1.	Vitreous attached behind at wound of exit; semifluid, suppurating: is shrunken to less than half its normal size.

Male, æt. 36. No. 1064.	Wound of right cornea, iris, and lens, with large fragment of iron: iris adherent to scar along its whole length: greater part of lens absorbed, small round cells within crumpled capsule; a linear detachment of retina running from below upwards to wound in cornea, patches of exudation in retina: well-marked papillitis.	6 weeks.	−T.	Infundibular detachment: the attachment to the papilla is by a very fine cord which widens out somewhat at the papilla. The vitreous is shrunken to a small opaque mass close behind the iris, is dotted over with punctate patches of suppuration. Some of these patches seem to be due to proliferation of the normal vitreous cells: others contain small round cells.
Male, æt. 35. No. 1080.	Injury by explosion of dynamite followed by (?) facial Erysipelas: kerato-iritis and hypopyon. Deep anterior chamber, absorption of lens: retina and choroid *in situ*.	10 weeks.	−T 1.	Infundibular detachment: streaks of lymph pass backwards from the pupil. Vitreous of normal consistence, and about half the normal size.
Male, æt. 54. No. 1085.	Blow with piece of wood; suppurative keratitis; severe iritis; lens cataractous: several small detachments of the retina.	14 weeks.	−T.	Infundibular detachment: similar to No. 1064. The greater part of the vitreous is, however, clear; but at one point there is a patch of semi-solid pus close to the ciliary processes.
Male, æt. 45. No. 1096.	Wound of globe by piece of steel: track of wound passes from edge of cornea to close to the optic nerve: piece of steel embedded here in sclerotic: anterior chamber very deep: several large detachments of retina.	8 years.	−T.	The foreign body passed through the vitreous; a firm solid cord passes from wound of entrance to wound of exit. Vitreous detached behind, and has undergone a fibroid change.
Female, æt. 12. No. 1125.	Large transverse wound of left cornea; lens absent: prolapse of iris. Suppurative cyclitis and retinitis.	6 days.	−T 1.	Globular detachment. Suppurative hyalitis. There had probably been some loss of vitreous at the time of the accident.

TABLE I.—*continued.*

Sex, age, and register No.	Nature of accident, with account of chief pathological changes in excised eye.	Interval between injury and excision.	Tension at date of excision.	Pathological changes in vitreous body.
Male, æt. 56. No. 1139.	Wound of right cornea and lens by a chip of steel. Electro-magnet introduced through wound, and foreign body removed. Lens extracted, formation of hypopyon: shallow anterior chamber: slight detachment of retina and choroid below.	3 weeks.	−T.	Infundibular detachment: the exterior attachment is 3 mm. behind ora serrata: commencing suppurative hyalitis.
Male, æt. 13. No. 1152.	Blow on right eye. Traumatic cataract: hypopyon: great swelling of iris: absorption of lens.	5 weeks.	−T.	Slight detachment around papilla. Commencing suppurative hyalitis. Streaks of pus spreading backwards from ciliary processes; anterior half of vitreous opaque; posterior half clear, and of normal consistence.
Male, æt. 40. No. 1174.	Blow on right eye. Traumatic keratitis: dense leucoma of cornea: anterior and posterior synechiæ: purulent cyclitis below.	6 years.	−T 2.	Infundibular detachment: solid localised mass of pus below over ciliary body: remainder of vitreous clear.
Male, æt. 21. No. 1178.	Right eye wounded just behind the ciliary region by a piece of steel: slight cyclitis. Retina, choroid, and vitreous adherent at scar.	1 month.	−T 1.	Slight infundibular detachment: a good deal of blood in vitreous close to the scar.

Male, æt. 10. No. 1181.	Punctured wound of left cornea, iris, and lens, by a knife. Wound reaches into upper ciliary region: iris adherent to wound: lens cataractous throughout, and partially absorbed: pus-cells spreading into it.	5 weeks.	T.n.	Commencing suppurative hyalitis. Vitreous detached behind but adherent at one spot internal to the papilla: evidently the track of the punctured wound.
Male, æt. 8. No. 1203.	Lacerated wound of right cornea and iris by a piece of slate. Lens absent, probably evacuated at time of accident: iris entangled in whole length of scar. Atrophic patch at macula: retina and choroid adherent together here.	3 weeks.	T.n.	Globular detachment. Vitreous occupies about half its usual space; is clear and of normal consistence: probably the detachment is due to loss of vitreous at time of accident.
Female, æt. 14. No. 1215.	Wound of left cornea, iris, and lens, by prong of a fork: anterior synechia to wound: lens greater part absorbed: retina and choroid *in situ*.	4 months.	—T.	Globular detachment evidently infundibular at a recent date from the tags attached to papilla and posterior surface of vitreous. Hyaloid membrane remaining with retina, but separating from it with great ease.
Male, æt. 10. No. 1230.	Wound of right cornea, iris, and lens: anterior synechia to scar: lens flattened and cataractous: retina detached slightly in one or two places.	1 month.	—T.	Globular detachment: suppurative hyalitis chiefly of anterior part, evidently starting from ciliary body.
Male, æt. 21. No. 1275.	Wound of right cornea and lens: anterior synechia to wound: deep anterior chamber: lens being absorbed: retina large, irregular detachment.	3 weeks.	T.	Globular detachment: commencing suppurative hyalitis.
Male, æt. 29. No. 1305.	Injury of left eye by gun-cap: recently great pain in eye: a solid mass of lymph above obscuring ciliary body: latter enlarged here: retina and choroid *in situ*.	14 years.	—T 1.	Infundibular detachment: very fine cord at papilla: centre of vitreous fluid.

TABLE I.—*continued.*

Sex, age, and register No.	Nature of accident, with account of chief pathological changes in excised eye.	Interval between injury and excision.	Tension at date of excision.	Pathological changes in vitreous body.
Male, æt. 12. No. 1345.	Wound of cornea by pair of scissors: anterior and posterior synechia to wound: cicatrix in retina and choroid external to papilla.	11 years.	T.n.	Vitreous detached behind, adherent at posterior cicatrix in retina and choroid: of normal consistence, with fibrous bands running through it.

TABLE II.—*Ulcers of Cornea—Perforating and Non-perforating.*

Male, æt. 63. No. 1089.	Right eye lost from old ulceration of the cornea: pain during last 3 or 4 weeks. Ciliary staphyloma, leucomatous cornea, with iris adherent to its posterior surface: lens close behind cornea: ciliary processes atrophied slightly: retina and choroid *in situ*: slight papillitis.	25 years.	T.n.	Globular detachment: vitreous occupying one-third of its usual space: it is clear and of normal consistence.
Female, æt. 13. No. 1146.	Purulent ophthalmia, perforating ulcer of cornea below, with prolapse of iris. Lower half of cornea flattened, thin, with iris firmly adherent to it: lens cataractous, lower part tilted forward to ulcer: retina detached in front of equator above: choroid *in situ*: the ciliary body is smaller and partially obscured by the opaque vitreous.	2 months.	−T.	Commencing infundibular detachment: the vitreous not being detached so much anteriorly: here, however, it has dragged on the retina and produced detachments of the latter: there is suppurative hyalitis in an early stage.

Male, æt. 4. No. 1182.	Ulcer of left cornea, resulting in staphyloma: cornea irregularly thickened: iris wholly adherent to cornea: lens cataractous and close to retina and choroid *in situ*.	2 years.	T. not noted.	Infundibular detachment: clear, below normal consistence.
Female, æt. 4. No. 1189.	Ophthalmia neonatorum resulting in a large prominent staphyloma of left cornea: the latter greatly thickened, iris frayed out and adherent to cornea: lens absorbed: choroid and retina *in situ*.	4 years.	−T 2.	Early stage of infundibular detachment: vitreous adherent at papilla, but detached all round as far as equator of globe: slow form of suppurative hyalitis: hyaloid membrane separates from retina with ease.
Female, æt. 24. No. 1238.	Gonorrhœal ophthalmia of left eye: perforation and flattening of cornea: iris swollen and covered by a thick layer of granulation tissue: lens absorbed: retina and choroid *in situ*: ciliary body enlarged.	7 weeks.	−T 1.	Infundibular detachment. Some fine streaks of pus pass backwards from the pupil nearly to the papilla: vitreous otherwise clear.
Female, æt. 54. No. 1295.	Right eye excised for a large infiltrated ulcer of the greater part of the cornea: the latter is very thin, but is not perforated: the anterior chamber is filled with pus: the lens is *in situ*, also the choroid and retina: there is some papillitis.	1 month.	T.n.	Early stage of infundibular detachment. Vitreous clear and of normal consistence.
Male, æt. 63. No. 1166.	Large superficial ulcer of cornea: latter deeply infiltrated with pus, and very thin: a large mass of pus in lower part of anterior chamber: pupil blocked with lymph: iris firmly adherent to anterior capsule of lens: retina and choroid *in situ*. Paracentesis of the cornea had been performed several times for evacuation of the pus: the latter, however, quickly reformed. Tension had been increased for some time previous to excision.	7 weeks.	T.n.	The vitreous is detached in an irregular manner behind: the posterior half has apparently become fluid: the hyaloid membrane is rather thicker than normal; is in contact with, but not adherent to, the retina.

TABLE III.—*Glaucoma.*

Sex, age, and register No.	Nature of accident, with account of chief pathological changes in excised eye.	Interval between injury and excision.	Tension at date of excision.	Pathological changes in vitreous body.
Male, æt. 43. No. 1104.	Subacute glaucoma in left eye: great pain for a fortnight before excision: no absolute glaucoma. Retina slightly detached above: lens opaque. Deep glaucomatous cup. The right eye is suffering from subacute Glaucoma with restricted field. Sluggish pupil, &c.	7 years.	T 3.	Slight detachment of vitreous all round the papilla: it is clear and of normal consistence.
Female, æt. 64.	Subacute Glaucoma. Sclerotomy performed upwards. A large bulging scar along whole length of sclerotomy incision, with prolapse of iris: lens pushed forwards. Retina swollen and inflamed, especially about papilla, which is obscured.	11 months.	T 1.	Globular detachment. Vitreous considerably shrunken.
Female. No. 1135.	Subacute Glaucoma of left eye, coming on very slowly: pain only during last month. Several large staphylomata of sclerotic at equator: dilated pupil, shallow anterior chamber: retina swollen, especially at papilla, detached in a ridge shape from before backwards.	16 years.	T 1.	Vitreous shows an early form of infundibular detachment. It is adherent all round the papilla, and as far as the macula; it is again adherent anteriorly at 5 mm. from the iritic angle. The canal of Cloquet is well seen.

Male, æt. 67. No. 1138.	Absolute Glaucoma of left eye: 2 months ago the right eye beginning to fail from Subacute Glaucoma, the patient noticed for the first time that the left eye was quite blind. Left eye at date of excision has no p.l., the cornea is hazy, margins vascular. Hypopyon, iris atrophied: some posterior synechia, O.D. only slightly cupped: choroid and retina *in situ*.	?	T 2.	Vitreous slightly detached from retina above: is fluid in centre; some opaque strings pass backwards from the ciliary body into its substance: the hyaloid membrane is separated from the retina in several places, and detached with the vitreous.
Male, æt. 66. No. 1160.	Absolute Glaucoma with secondary cataract: anterior chamber of fair depth: iris very markedly adherent to cornea at angle of anterior chamber: retina and choroid *in situ*: O.D. cupped.	18 months.	T 1.	Vitreous is clear, solid consistence, is detached between papilla and the ora serrata at the inner side: at the outer side it is abnormally adherent to the retina, so that the latter is easily detached on pulling hold of the vitreous: there is marked proliferation of vitreous cells at this spot.
Female, æt. 68. No. 1169.	Hæmorrhagic retinitis, secondary Glaucoma, sclerotomy performed upwards without producing diminution of tension: no cause for hæmorrhages assignable.	2 years.	T 1.	Well marked infundibular detachment.
Male, æt. 66. No. 1179.	Subchoroidal hæmorrhage followed by secondary glaucoma: cornea infiltrated: posterior synechiæ: large hæmorrhage pushing choroid and retina forward. Tension never very greatly increased: O.D. deeply cupped.	3 years.	T +	Infundibular detachment. Vitreous becoming vascular, and being converted into connective tissue: several large hæmorrhages in its substance.

TABLE III.—*continued.*

Sex age, and register No.	Nature of accident, with account of chief pathological changes in excised eye.	Interval between injury and excision.	Tension at date of excision.	Pathological changes in vitreous body.
Female, æt. 67. No. 1255.	Absolute Glaucoma: quite blind for last 5 years: secondary cataract during the last 6 months: large hypopyon formed a week or two before excision: good anterior chamber. Capsular cataract, with degeneration of lens fibres: thickening of suspensory ligament of the lens: iris swollen and inflamed: choroid and retina *in situ*: some pigmentary retinitis: deep glaucoma cup.	6 years.	T +	Commencing suppurative hyalitis. Vitreous detached behind and shrunken to half its normal size: the cord connecting it with the papilla is torn across, probably during shrinking of vitreous.

TABLE IV.—*Sympathetic Ophthalmitis.*

Male, æt. 28. No. 1164.	Severe gonorrhœal ophthalmia of right eye, resulting in perforation of the cornea below: left eye not affected: excision of right eye recommended, but refused at the time. Return of patient in 2 months' time with sympathetic ophthalmitis in left eye. Excision of *right* or *exciting eye*, which is now shrinking: with flattened thickened cornea: iris swollen and surrounded by layer of connective tissue: lens	2½ months.	−T 2.	Greater part of vitreous is absorbed: what remains is drawn forwards and adherent to the iris and ciliary body: a central solid fibroid cord passes backwards to, but does not quite reach, the papilla.

	absorbed: retina detached in a ridge below, and greatly swollen at the papilla; several localised inflammatory foci both in iris and choroid.			
Female, æt. 62. No. 1102.	Preliminary iridectomy on each eye. Extraction of cataract in the left eye. Subsequent needling resulting in vision $= \frac{20}{20}$ and J 1; sympathetic ophthalmitis of right eye; ultimately excision of right.	6 months.	T. full.	Well marked infundibular detachment; vitreous dotted with numerous minute foci of inflammation.
Female, æt. 58. No. 1243.	Right eye lost 6 years ago by ulceration of cornea with probable perforation: excision was recommended then, but refused by the patient. The *left* eye began to fail 4 months ago; now there are several synechiæ in this eye, with slight opacity of the lens. It is questionable whether the iritis is sympathetic or not. The *right* eye had no p.l., and was now excised and presented the following changes. Cornea flat and irregular in thickness: numerous anterior synechiæ; iris somewhat atrophied: lens cataractous: choroid and retina adherent at several spots: pigmentary retinitis: large patches of choroidal atrophy: optic disc has a deep glaucomatous cup. Microscopically there is evidence of old choroido-retinitis: the pigmentary epithelium of the retina is disturbed; there are groups of small cells in choroid and retina, especially at the points of adhesion.	6 years.	T 1.	Infundibular detachment of the ordinary type: at one place below the vitreous is firmly adherent to the retina, and from its gradual shrinking has detached the latter to a considerable extent.

TABLE V.—*Extraction of Cataract, &c.*

Sex, age, and register No.	Nature of accident, with account of chief pathological changes in excised eye.	Interval between injury and excision.	Tension at date of excision.	Pathological changes in vitreous body.
Male, æt. 62. No. 1119.	Extraction of cataract in the middle of April, 1882. Opaque membrane needled 12 months later: secondary glaucoma following needling: iridectomy performed downwards: 2 weeks later paracentesis of the cornea as the tension was still unreduced. Escape of a small quantity of vitreous; excision a fortnight later, as tension was still increased. Condition of excised eye was as follows: The pupil occluded by recent inflammatory exudation, iris discoloured: a dense layer of lymph covers its posterior surface: several small detachments of the retina, one extensive one anteriorly due to dragging of the vitreous.	1 year.	T+	Well marked infundibular detachment, the vitreous greatly diminished in size, much more than would be accounted for by the slight loss during paracentesis: it is solid and clear.
Male, æt. 4. No. 1145.	Congenital cataract. Each eye needled 3 times at intervals of 2 or 3 months. The left eye needled for the 4th time on April 21st, 1883. Was followed by hypopyon, and suppuration along the track of the needle puncture: the pus was absorbed, but the eye remained red and tender, and tension became greatly reduced. At excision a month after the last needling, the cornea was clear, good anterior chamber, iris	1 year.	−T 2.	Vitreous greatly shrunken, wholly detached behind: projecting backwards from the pupil is a slightly opaque solid cord, which has recently been adherent at the papilla: the hyaloid membrane is also separated with the vitreous.

	fairly bright, pupil occluded: iris covered behind by a dense thick layer of lymph: retina swollen and opaque, especially at papilla: both choroid and retina *in situ*. Microscopically small foci of inflammatory cells both in iris and retina: marked papillitis.			

TABLE VI.—*Recurrent Iritis.*

Female, æt. 59. No. 1168.	Extraction of senile cataract followed by iritis: pain for some weeks before excision. There is a depressed scar along the corneal flap. Cornea thickened here: iris greatly swollen, suppurative iritis: papilla swollen.	2 months.	−T 2.	Infundibular detachment: suppurative hyalitis localised in the lower part of the vitreous.
Female, æt. 20. No. 1340.	Patient suffering from congenital cataracts. The eyes are small, nystagmus is present: 5 or 6 needling operations have been performed on each eye at various times during the past 10 years. The left eye has become painful and glaucomatous as the result of a needling a year ago: V = shadows. T 2. As the patient was suffering great pain, excision was performed. The eye is rather small, with a very deep anterior chamber, pupil round and large: ciliary body rather small: retina slightly detached near ora serrata. O.D.: glaucomatous cupping.	10 years.	T 1.	Well marked infundibular detachment. Vitreous occupies about $\frac{1}{3}$rd its normal space: is of normal consistence: from its shrinking it has produced a slight detachment of the retina anteriorly: the hyaloid membrane is separated from the retina and floating between it and the detached vitreous.

TABLE VI.—*continued.*

Sex, age, and register No.	Nature of accident, with account of chief pathological changes in excised eye.	Interval between injury and excision.	Tension at date of excision.	Pathological changes in vitreous body.
Female, æt. 57. No. 1260.	Recurrent iritis in each eye: the first attack 3 years ago, after living in a very damp house, and contracting rheumatism. In July 1882, iridectomy was performed on *right* eye: following September had iridectomy performed on *left* eye, which had a secondary cataract: since then she has had great pain in *left* eye. In February 1883, the cataract was extracted from the *left* eye with only temporary relief of pain: in October 1883, the coloboma was completely occluded, there was a shallow anterior chamber, bare p.l. and − T 1, with considerable pain. Excision of the *left* eye was performed. The following pathological changes were found: the iris entangled in the corneal section, considerably thickened: ciliary body greatly swollen: retina and choroid detached in several places to a slight extent: marked papillitis: retina inflamed, especially round blood-vessels.	3 years.	− T 1.	Infundibular detachment of the vitreous: the anterior part of the retina is detached from contraction of the vitreous: behind the iris is a peculiar interlacing of fine fibrous cords: these cords intercommunicate and are continuous with the vitreous behind. They consist microscopically of ill-developed fibrous tissue: the whole vitreous is tough, and is becoming fibrous: there is great increase in the number of small cells scattered through it: the branched cells are not increased.

PART II.—*Two Cases of Intra-Ocular Sarcoma, producing Sympathetic Ophthalmitis.*

THE two following cases of intra-ocular sarcoma, taken together with that brought forward by Dr. Brailey in this number of the Reports, are of great interest, as they all produced sympathetic inflammation of different degrees of severity. In the first case the damage done to the sympathising eye was so severe, that there was almost total loss of sight. In the third case (see Dr. Brailey's paper), though by no means severe, yet the inflammation produced permanent damage to the sympathising eye. In the second case the inflammation was of the very mildest form, but yet was undoubtedly sympathetic. In Cases I. and III. there was an evident perforation of the cornea. In Case II. there was no perforation whatever, though a very careful examination was made. In each instance it is probable that the tumour which grew from the choroid, produced an irritation and inflammation of the latter structure, a true form of sympathetic choroiditis of the exciting eye. It is possible that in Cases I. and III. the perforation was the exciting cause and not the sarcoma; this is more in accordance with the views held on sympathetic ophthalmitis. This cannot, however, hold good in Case II, where no perforation was present, and one is compelled to acknowledge that an intra-ocular sarcoma may alone be the direct exciting cause of sympathetic affection.

CASE I.—*Sarcoma of Choroid—Spontaneous Perforation of Cornea—Sympathetic Ophthalmitis.*

No. 1235. Samuel B., æt. 50, a stableman, was admitted under the care of Mr. Gunn, on August 19th, 1883. The sight of his right eye began slowly to fail, without any pain, four years ago; in three months it had almost completely gone. He first had pain in it a week before admission, when "something burst in the eye and water ran out." The pain then became

very severe, and he now noticed for the first time that the left eye was becoming dim; four days previous to admission he was able to read a newspaper without discomfort. The left eye had always been a good one, so there is little doubt that it had only been affected within the last two or three days.

The following are the notes on his first coming to the Hospital:

Right or Exciting Eye.—Cornea opaque, several large vessels covering it; below is a small perforation of the cornea with prolapse of iris; pupil is just visible through opaque cornea, and is filled with lymph. — T. 1. No perception of light.

Left or Sympathising Eye.—Ciliary congestion, no punctate spots on the cornea, several posterior synechiæ. Only a red reflex from the fundus; no details visible. $V = \frac{20}{100}$. T.n.

The right eye was excised.

Before giving a description of the appearance found in the right eye, it may be convenient to give the progress of the sympathetic inflammation in the left eye, from the in-patient notes.

Left or Sympathising Eye did not improve after the excision of the right eye; it remained congested, the posterior synechiæ did not give way to atropine, but increased in number till the pupil became nearly occluded. Keratitis punctata appeared, the aqueous became muddy, and the vitreous hazy. In spite of the use of atropine, counter-irritants, and rigid exclusion from light, the eye slowly became worse, and vision diminished from $\frac{20}{70}$ to counting fingers at 4″.

Description of Right or Exciting Eye.—The eye was hardened in Müller's fluid for one month; it was then frozen, and an antero-posterior section made. A dark irregularly pigmented solid tumour fills the posterior part of the globe; it is somewhat mushroom-shaped, with a broad base of attachment to the posterior part of the sclerotic, external to the optic disc. It is pale in the centre, where it breaks down rather easily, becoming darker at the edges. The *cornea* is thickened in an irregular manner, and flattened; there is a central perforation. The *iris* is adherent to the cornea, and atrophied. The *lens* is absent. Between the iris and the front surface of the tumour is a

space 3 mm. in breadth filled with an old blood clot. The *retina* and *vitreous* are not visible. The *choroid* is detached anteriorly, and distinctly thickened. It is continuous with, and involved by, the tumour. At one spot, just internal to the papilla, a cross section shows a marked globular swelling of the choroid, which is to all appearance a secondary growth. The *Optic nerve* is not implicated in the growth, as far as the naked eye appearances show. The sclerotic is of normal thickness.

Microscopical Examination.—The cornea is vascular (the section does not pass through the perforation), and the epithelial layer is greatly thickened. The iris is adherent to the cornea, and atrophied. The lens is almost completely absorbed, the capsule puckered, and the capsular epithelium proliferating. The ciliary body is rather small, and separated from the sclerotic behind through traction of cicatricial tissue dragging it towards the middle of the globe, and the anterior part of the choroid has been detached from the sclerotic by the same means. Both the ciliary body and the anterior part of the choroid contain foci of inflammatory cells; the choroid more especially is very densely crowded with cells, a parenchymatous choroiditis. The tumour is a spindled-celled sarcoma; it is very vascular, especially in the periphery, where there are numerous dilated blood-vessels, with greatly thickened walls. The margins of the tumour are rather deeply pigmented in parts; the centre remains unstained, and is undergoing fatty degeneration. The tumour evidently originated in the choroid; the enlarged part of the choroid internal to the papilla is infected with the same cells as are present in the tumour. The character of the cells of the choroid change towards the equator of the globe in a most marked manner; whereas in the posterior half they are spindle cells, in the anterior half they are evidently of inflammatory origin. In front of the tumour there is a mass of blood, apparently becoming organised in parts. The retina is almost completely destroyed. The optic nerve is not infected with the growth, but contains a large number of cells.

Case II.—*Melanotic Sarcoma of Choroid—Suppuration of Vitreous—Shrinking of the Eyeball—Sympathetic Ophthalmitis occurring three weeks after Excision.*

No. 1370. Thirza P., 40 years of age, was admitted into the Hospital under the care of Mr. Tweedy, on February 22nd, 1884. For some few months past she has noticed that she was unable to see objects to her left side; she had some aching in her left eyeball for the first time six weeks ago. The following day the pain became excessively severe both in the left eye and temple; sickness and vomiting occurred, lasting till next day; and the lids became greatly swollen. The pain lasted four days, and was relieved by leeching. She has had no blow on the eye.

She is one of a family of seven children, who were all healthy. Her father died from phthisis: her mother from "cancer of the womb." She has always been a strong woman up to the present illness. She now looks aged, worn out, and pale.

The left eyeball is shrinking and becoming squared; the whole cornea is opaque, with a yellow line at the limbus; the iris is invisible; T.—; no perception of light.

The right eye is normal. $V\frac{20}{20}$ and J. 1.

On excision of the left eye, on February 22nd, the following changes are found.

The sclerotic is greatly thickened and puckered from shrinking of the eyeball. The cornea is small and considerably thickened. There is no visible perforation of the globe. A small black oval tumour is growing from the choroid just external to the papilla; it measures 4 mm. in the antero-posterior direction. In front of the tumour, and occupying the vitreous cavity, is a mass of greyish, friable material, looking like inspissated pus. The lens is absent, and the iris is adherent to the cornea. The choroid is abnormally pigmented, the pigment having accumulated in masses. The retina cannot be traced by the naked eye. The optic nerve does not seem to be involved in the growth.

Microscopical Examination.—The cornea is vascular and sclerosed; the anterior layers, especially at the corneo-scleral margin, are densely packed with round cells of inflammatory

origin. The ciliary body is enlarged on one side, and inflamed. The mass occupying the vitreous cavity consists of caseating pus; the posterior part of this mass has a few cells scattered through it, which are deeply stained; the greater part does not take the stain at all. There are some localised masses of blood here, and a large number of oil globules. The tumour is very deeply pigmented, so much so, that it is impossible to make a section of the central part thin enough to make out its structure; the margins, however, are less deeply pigmented, and show more clearly that it consists for the greater part of round cells, with a tendency to the formation of spindle cells and fibrous tissue in parts. A part of the choroid on the inner side of the papilla is distinctly infected with the sarcoma, though only to a slight extent. The choroid anteriorly is evidently inflamed and thickened by a growth of small cells. The retina is almost completely destroyed; a trace of it is visible close to the papilla. The optic nerve contains more nuclei than normal; that half of it which is nearest to the sarcoma contains pigment scattered irregularly through it, though there is no other evidence of the nerve being infected by the growth. The pigmentation did not quite reach back to the point where the nerve had been divided at the excision of the eyeball.

The patient was readmitted into the Hospital on March 14, 1884, nearly a month after the eye had been excised. The following notes were made by Mr. Lawford, the House Surgeon.

The patient thought herself well after leaving here till fourteen days ago, when she noticed a mist over the right eye, not permanent, but coming and going. There was some photophobia, and the eye was a little blood-shot.

Right Eye.—No ciliary congestion; very fine dots on posterior surface of cornea, chiefly central, and at the lower part; pupil rather wide, acts fairly to light; two small dots of pigment on anterior capsule. V = 4 J. unaided, $c + 1$ D., 1 J. barely: $c + 1{\cdot}5$ (after atropine) $\frac{20}{40}$. T.n.

For the following further notes of this case I am also indebted to Mr. Lawford.

In the *left orbit* there is seen a small black nodule in the

centre of the stump, thought to be a recurrence of the growth. There is no pain or tenderness. Patient is still very anæmic and thin, with a poor appetite.

Gutt. atrop. sulph. gr. 4 ad 1 oz. ordered, to be used twice daily to the right eye, and a large shade to be worn. Quinine was administered internally.

March 18. The right pupil has responded very slightly to the atropine. Contents of left orbit removed, and chloride of zinc paste applied.

March 24. *Right eye.*—No congestion; pupil half wide.

April 10. *Right eye.*—A few fine dots can still be seen in the cornea, not in groups, but scattered over cornea singly; there are no synechiæ. Aqueous and vitreous humours clear. Optic papilla and other parts of fundus appear healthy. $Vc + 1$ D. $= \frac{20}{20}$ (atropised).

April 26. Patient left the Hospital.

On November 8, 1885, she writes to say that the sight is "fairly good;" that the eye looks bright, but that she sometimes suffers from sharp pains in the eye and temple.

Part III.—*Two Cases of Sympathetic Inflammation of Eyeball.*

Case I.—*Traumatic Keratitis — Staphyloma of Cornea followed by Sympathetic Ophthalmitis—Excision of Exciting Eye—Sclerotomy in Sympathising Eye with Ultimate Excision.*

No. 1163. Joseph S., æt. 58, a labourer, was injured in the right eye by a twig while he was hedge cutting in December 1881. It is questionable whether there was a perforating wound at the time. Traumatic keratitis with staphyloma of the cornea resulted; the sight slowly failed with considerable pain for some time after the accident. In the following June the right eye was quite blind. In the middle of July (7 months after the accident) the left eye "became misty and watered." The patient came to the Hospital on September 18th, 1882, when the following condition was noted.

Right (exciting) eye. Cornea staphylomatous, opaque, and vascular; eye not tender or painful.

Left (sympathising) eye. Ciliary congestion; cornea dull and steamy; several posterior synechiæ, which do not yield to atropine: no keratitis punctata. T.n.

The right was excised and presented the ordinary appearances of a staphylomatous cornea; the latter being irregularly thickened, with the iris frayed out and adherent to its posterior surface; the lens was absorbed.

The left, or sympathising eye, soon became painful from increased tension; keratitis punctata appeared, and the posterior synechiæ became more numerous. The pupil became completely occluded, and on November 29th, a sclerotomy was performed, as there was T + 2, with aggravation of pain. The patient was discharged on December 9th with tension still increased.

He returned on June 23rd, 1883. His remaining eye was excessively painful and tender to touch, preventing him from sleeping at night. There was great ciliary congestion, cornea opaque and flattened, with a few straggling vessels on its surface. T + 1, no perception of light. The eye was excised.

Description of Sympathising Eye.—The cornea is rather small and flattened; its surface is slightly irregular, and thrown into vertical folds. An antero-posterior section of the eyeball shows a very thick solid mass filling up the anterior quarter of the globe. The iris and ciliary body are so involved that they are indistinguishable. The lens is surrounded by this solid mass, and is displaced upwards and backwards with its upper edge tilted forward. The retina is detached in an infundibular form and considerably thickened. There are some remains of the vitreous. The choroid is greatly thickened, especially anteriorly, where it becomes continuous with the above-mentioned solid mass.

Microscopical Examination.—The cornea is sclerosed, most markedly in the posterior layers. Descemet's membrane is puckered and covered, in front and behind, by several layers of long spindle-shaped cells, arranged in the same plane as itself. The solid mass behind the cornea has involved the whole iris and ciliary body. It consists of connective tissue in various stages of development; round cells, spindle cells, and fibrous tissue being present. The pigment from the iris and ciliary body is scattered irregularly through it. The dislocation of the lens is due to the contraction of this cicatricial

material. The capsule of the lens is destroyed in the upper part.

CASE II.—*Preliminary Iridectomy on Each Eye—Extraction of Cataract from the Left Eye, resulting in permanent good Vision—Sympathetic Ophthalmitis in Right Eye.*

No. 1102. Jane G., æt. 62, presented herself at the Hospital at the beginning of the year 1882. She had immature cataracts in each eye, the left cataract being rather more advanced than the right; her eyes were otherwise quite normal. She had always been a strong healthy woman. On February 20th, 1882, a preliminary iridectomy was performed on each eye, with an uninterrupted recovery. On June 15th, the cataract of the left eye was mature, and a modified Graefe extraction was performed without any complication. No reaction occurred, and the patient left the Hospital in three weeks with a perfectly active pupil, and no entanglement of iris in the operated eye. Three months later (September 5th) the vision of the left eye was—

$$c + 10\ \text{D.}\ \frac{20}{70};\ c + 14\ \text{D. J. 6.}$$

There was a fine membrane over the whole pupillary area. This was now torn through with a needle, with the result that 10 days later—

$$\text{V} = c + 10\ \text{D.}\ \frac{20}{30};\ c + 14\ \text{D. J. 1 at 8}''.$$

The cataract in the right eye was maturing slowly, V = fingers at 1′, the eye otherwise normal. Two months later (about the middle of November) the right eye became uneasy and painful. She did not return to the Hospital till January 1883, as she considered that the rapidly increasing dimness and pain of the right eye were due to the ripening of the cataract. The right eye had now all the appearances of an acute severe sympathetic inflammation. There was great ciliary congestion: there were numerous dots on the posterior surface of the cornea, some of them running into plaques; the aqueous was muddy; the iris swollen and discoloured, with firm posterior synechiæ; the anterior capsule of the lens was also covered with large dots. The eye was painful and tender, T + 1, V = shadows. The

patient was kept in a dark room; atropine and leeches were used without any relief to the pain or tension. A sclerotomy was also performed without diminishing the symptoms. Finally, the eye was excised in April 1883.

During all this period the *left* or *exciting eye*, on which the extraction of cataract had been performed, showed absolutely no signs of inflammation or even congestion. On very careful examination, not the slightest evidence of entanglement of iris or of the lens capsule could be detected in the corneal scar: the latter did not reach into the sclerotic: the pupil was active, no posterior synechia was present, the vitreous remained clear; no papillitis or congestion of the retina was ever recognised. The vision with proper correction with glasses was $\frac{20}{20}$ and J. 1, and has remained so up to the present time. In fact a better result from extraction of a senile cataract could not be desired.

Examination of Sympathising Eye.—The globe is of normal size. The cornea is covered on its posterior surface with dots of varying size; in the lower part these have coalesced and formed a large plaque. The anterior chamber is of normal depth: the iris is swollen, discoloured, and glued to the anterior capsule of the lens; in the coloboma produced by the iridectomy, the anterior capsule is clearly seen to be covered with dots. An antero-posterior section of the globe is made: the anterior capsule is found to be thickened; the ciliary body is swollen. The vitreous is of rather firmer consistence than normal; it is detached behind in an infundibular manner, being still adherent at the papilla, but detached between this point and the ora serrata: its posterior surface is covered by numerous opaque punctate spots. The retina and choroid are *in situ*, the former being slightly thickened.

Microscopical Examination.—The cornea is somewhat inflamed: there are a considerable number of small round cells scattered through it. On the posterior surface of Descemet's membrane is a layer of cells of varying size and shape. Some of these cells are small, and stain deeply; others are large, with a single or double nucleus: these latter are evidently due to the proliferation of the epithelium of Descemet's membrane. The cells are collected in clumps, and form the dots which were visible to the naked eye: a large number of the cells are under-

going fatty degeneration. Schlemm's canal is completely filled up with small round cells. The iris is adherent to the cornea at the angle of the anterior chamber for some distance: it is very greatly thickened and densely packed with cells; the blood-vessels are enlarged, with greatly thickened walls. There is marked cyclitis: the ciliary body, however, is not much enlarged. The lens shows the globular enlargement of its fibres very distinctly; its capsule is covered anteriorly by cells of the same appearance as those lining Descemet's membrane: this layer of cells has glued the iris to the anterior capsule. The vitreous contains a great number of cells, arranged chiefly in groups. These cells are for the most part similar to normal vitreous cells; they are large, usually globular, with two or three nuclei; only a few are branched; their number is greatest in the posterior part, along the hyaloid membrane. The latter is detached with the vitreous. There is marked choroiditis. The retina is very slightly affected; here and there there is a group of cells in the anterior layers, these are most evident near the papilla.

INTRA-OCULAR SARCOMA EXCITING SYMPATHETIC DISEASE.*

By W. A. Brailey, M.D.

Assistant Ophthalmic Surgeon to Guy's Hospital; Ophthalmic Surgeon to the Evelina Hospital.

Eliza Masters, æt. 29. Admitted to Moorfields Hospital on August 18, 1882.

Two years ago she noticed that her *left* eye could not see objects to its outer side. Many people had recently remarked to her that that eye had begun to squint. Previously it had appeared, both to her and others, perfect in every respect. Twelve months later the sight had entirely gone. She never had any pain worth speaking of. *The sight of the right* eye began to fail about three weeks before admission.

When first seen on August 8, 1882, the *right* had well marked keratitis punctata; its pupil dilated round to atropine, though the iris was dull with some ciliary redness. There was well-marked optic neuritis. T.n.

The *left* eye had T. + 1. It was evidently shrinking, and the sclerotic of the upper ciliary region was puckered. The cornea was flattened, hazy, and vascular; the pupil large and occluded by a thin layer of lymph. There was no fundus reflex.

Examination after enucleation on Aug. 18, 1882:—The iris was rolled forward by contraction of its anterior surface; its posterior surface was adherent to the lens capsule; from its pupillary edge a thin layer of lymph extended all over the pupillary area. The retina was detached into an umbrella shape. A sarcomatous thickening occupied the upper and inner part of the choroid, its margin just encroaching upon and surrounding the optic disc. This tumour-mass measured about 10 mm. in depth from before backwards, and the same in lateral diameter. In section it presented a vascular greyish surface, through which a good deal of pigment is irregularly distributed.

Microscopical Examination showed it to consist of small round cells, which in certain areas are pigmented, in two places so

* This case is referred to in Dr. Brailey's paper on Sympathetic Ophthalmitis in "Transactions of the Ophthalmological Society," vol. iv, p. 66; and by W. J. Milles, "Trans. Ophth. Society," vol. iii, p. 66.

excessively as to constitute well-defined, coal-black patches. Towards the median line of the body the tumour thins off gradually, whereas on the outer side of the disc the bulk of the tumour-mass ends abruptly as a convex overhanging edge, though the choroid beneath it still contains a considerable number of tumour-cells for a little distance. The pedicle of the detached retina near the centre of the optic disc is constricted all round by the much-thickened sarcomatous choroid. It is highly pigmented, and numerous small tumour-cells, most of them pigmented, extend into and very much thicken the optic nerve for a distance of 2 mm. The rest of the choroid shows the inflammatory appearances described by the author ("Trans. Internat. Med. Congress," London, 1881) as typical of the choroiditis maligna which produces sympathetic disease. The ciliary body presents changes equally characteristic of the same diseased condition. Its pigment is irregularly proliferated, as is also that of the iris, which is also inflamed, though probably less so than formerly.

Mr. Milles' notes record the further progress of the *right* eye. It remained the same up till about Sept. 7th, when the dots on the cornea were noted to be diminishing. The optic neuritis was about the same. Three weeks later the patient left the hospital, some swelling of the disc being still visible. The vision was not noted either time.

Nine months later she was seen again, having been using atropine almost continuously since discharge. The eye was then noted as normal in every respect.

In connection with this case, it must be remarked that it is not the sarcoma itself directly, but the uveitis produced by it, which gives rise to the sympathetic inflammation. Also that the inflammatory appearances in each eye are, in the opinion of the author, exactly typical of the inflammation occurring with sympathetic disease. Thirdly, that notwithstanding one's prejudice against enucleation, this case furnishes another of those rather numerous examples where the process of sympathetic disease has appeared to be favourably influenced by excision of the exciting eye.

(The above case is alluded to by Mr. Milles as Case III. in his paper on this subject at p. 43.)

MISCELLANEOUS OBSERVATIONS AND CASES.

By E. Nettleship.

(Continued from Vol. IX, p. 198.)

The cases narrated below illustrate, amongst other points, certain results of blows upon the eye; remote consequences of syphilitic choroido-retinitis; recovery from severe renal retinitis occurring in pregnancy; cases of tobacco amblyopia with inflammatory appearances and hæmorrhage near the disc; an additional case of tobacco amblyopia with diabetes; a remarkable case of myopic choroiditis; nystagmus of one eye only in three brothers; choroido-retinal changes following exposure to sunlight.

The two cases of renal neuro-retinitis illustrate what is, I believe, the rule, viz., that when eye-changes occur in the albuminuria of pregnancy they are often very severe, whilst yet the prognosis both for life and sight is often better than when retinitis of far less severity accompanies the chronic granular kidney. Sight, however, is not always recovered, and I have lately seen a woman who is now nearly blind from atrophy, following severe neuro-retinitis from albuminuria during pregnancy; her urine still contains albumen, but she is in fair health.

The two cases of tobacco amblyopia are particularly interesting, since they supply striking evidence that the pathological process in this disease is at first inflammatory, and not, as has often been assumed, atrophic. Axial neuritis has, of course, been found *post-mortem* in several cases of central amblyopia, during the last four or five years; and the discs in early cases of central amblyopia have often been seen to be congested and hazy: but I do not know that hæmorrhages have been actually observed before. The case of amblyopia in a smoker with

diabetes adds nothing to our previous knowledge; we want cases of amblyopia from diabetes in persons who do not smoke, and of this Hirschberg's case in a woman is, I believe, the only good instance on record (Centralblatt, 1882, p. 202).

The notes of many of the cases have been taken by my clinical assistants, and I have especially to thank Mr. W. H. Jessop for his help in following up many of the patients and arranging some of the notes. I have always myself made or carefully verified the notes of the ophthalmoscopical appearances.

On Miosis in Irritation of the Eye.

It is a very common thing to see the pupil contracted in an eye whose cornea has been scratched or has given lodgment to a foreign body; and the pupil of an eye affected by corneal ulcer is also sometimes smaller than that of its fellow. In these cases the mobility of the pupil is not affected. In the common cases of abrasion and foreign body careful inspection will very often show that the iris of the affected eye is a little discoloured, greenish, as if iritis were threatened. This change of colour is no doubt properly accounted for by vascular engorgement of the iris without any effusion, and the diminution in the size of the pupil may be explained by the congested iris encroaching a little on the area of the pupil. It is probably correct to speak of the condition in such cases as congestion-miosis. But there are some cases of miosis following abrasion, &c., in which there is scarcely any ciliary congestion and no appreciable discoloration of the iris, although the eye is intolerant of light; and there are cases of miosis in eyes which have suffered some time before from ulcer of the cornea, but have recovered with the exception of the scar. It is not easy to explain the contraction of the pupil in these cases; if the miosis were due simply to increased irritability of the retina associated with increased irritability of the fifth nerve, we should

expect it to be more common than it is, and its degree should be in some measure proportionate to the intolerance of light; and such is certainly not the case.

Neuralgia in Cataractous Eyes.

Occasionally a patient complains of troublesome neuralgic pain in an eye with incomplete cataract. It is a question here whether the cataract is, in any way, a consequence of the pain, or whether both are associated with a common cause. Defective circulation is often a cause of local pain in arthritic maladies. Uniocular cataract has lately been attributed to lowered nutrition of the lens depending on atheroma of the corresponding carotid artery, which lessens the blood supply to the eyeball. Possibly some cause hindering the blood supply to the eyeball in some of its parts, especially in the ciliary region, may account, both for the neuralgia in persons predisposed to it, and for the cataract.

The neuralgia here referred to is to be distinguished from the aching in the eyes and over them, which is common in incipient cataract. The latter, I believe, depends upon muscular strain on the internal recti and, perhaps, the ciliary muscle, in the efforts which such persons make to compensate for their amblyopia by bringing the book closer than they have been accustomed to. The same effort to see near objects by looking more closely at them, I believe, often explains the dull frontal aching of which patients suffering from tobacco amblyopia so frequently complain on being questioned.

Vascular Supply of the Optic Disc.

There are clinical and pathological reasons for thinking that the intraocular end of the optic nerve more easily undergoes inflammatory change than parts of the nerve further back. It is well known that the disc may be very much swollen and inflamed, whilst the trunk of the nerve

shows comparatively insignificant changes, although, as can now hardly be doubted, the morbid process has travelled from the brain down to the eye, affecting most violently the part last reached. This proclivity of the disc to inflammation probably depends upon its having a freer blood supply than the rest of the nerve.

That the blood reaches the disc more readily than the rest of the nerve is shown by an imperfectly injected human optic nerve (M. 1, 5), sections of which show that, although the capillaries of the nerve generally are very imperfectly injected, those of the lamina cribrosa are much better filled than those of the parts further back.

Exactly Symmetrical Corneal Ulcers.

The corneal ulceration in purulent ophthalmia is usually symmetrical and situated below the centre. Solitary phlyctenulæ, whether on the conjunctiva or cornea, are often symmetrically disposed on the outer, less commonly on the inner, side of each globe. The corneal changes due to the friction of granular lids are almost invariably limited for some time to the part of each cornea on which the upper lid lies. We sometimes, however, meet with quite symmetrically disposed ulcers of the cornea, due neither to the lodgment of purulent discharge on the lower part of the cornea, nor to exposure of the surface of the eyeball, nor to friction by roughened lids. Thus, William R., 37, a cabdriver, had in July, 1884, a small well-defined ulcer at the junction of the upper with the inner quadrant, and midway between the margin and the pupil, in each eye; the symmetry was precise. No foreign body nor other cause of local irritation could be found, but the man himself thought that the eyes, which had been bad for some weeks, had been inflamed by small "green flies" getting into them.

It is not likely that such cases as this, and others which could easily be quoted, are really examples of any general tendency to symmetrical disease of cornea; pro-

bably all that they show is precise symmetry of the form and movements of the parts concerned.

Commotio Retinæ; Radiated Striation of Retina.

Walter A., æt. 9, was struck on the *right* eye by a cricket-ball on June 4th, 1883. He came to Moorfields on the 6th (48 hours after the accident).

This eye showed ciliary congestion; pupil dilated and pear-shaped, with the point downwards, measuring 45 mm. × 6·5 mm., and acting slightly to light. A streak of blood is seen on the iris. $V = \frac{20}{50}$, with -1 D $= \frac{20}{20}$, and 1 J. p. p. $= 4''$. Well-marked, *radiating*, watered-silk appearance around yellow spot; fundus well seen with -1 D. Left eye normal; pupil = 2·3 mm. in good light, $V = \frac{20}{20}$, watered-silk appearance much less marked than in right. Ordered blisters and atropine. On June 9th right pupil round, and extremely wide (10 mm. at least); radiating watered-silk striation as before.

The point in this case is the presence of streaks of shifting white haze *radiating* from the fovea centralis over the whole region of the yellow spot. This appearance is by no means uncommon after blows upon the eye in children, and, as the next case shows, may be permanent; I believe it is seldom seen from any other cause than injury.

Central Changes in Retina and Choroid remaining ten years after a Blow on the Eye.

Thomas Daws, now 20, had a blow on the left eye by a fist when he was ten years old. Just below the yellow spot in this eye there is a small spot of partially atrophied choroid, with slight, radiating, striated haze of retina near it. The optic disc is perhaps paler than that of the other eye. The eye had squinted since childhood, and, apart from the choroidal disease, would probably have been defective from its high degree of

astigmatism; V (with +3 D. sph. and +3 D. cyl.) = $\frac{6}{36}$.

Right V = $\frac{6}{6}$. Hm. 0·5 D. Ophthalmoscopic appearances normal.

Concussion of Retina with Hæmorrhages, by direct violence. Graphic description of mode of return of Sight. Slight permanent changes at optic disc.

Clara S., married, æt. 25, in good health, the mother of three children, came to Moorfields on September 26, 1885. She said that two days before, when shaking a jacket trimmed with round, satin-covered, wooden knobs, her right eye received a severe blow from one of these. It caused her much pain, and she was totally blind of the affected eye for three hours, and the eyelids afterwards became much swollen; she did not vomit. The sight began to return about three hours after the accident; at first "it was like a small bright light in a dark room," and gradually the sight enlarged and improved to the state in which we found it on admission.

Condition of the injured (*right*) eye on admission:—V = 16 J. at 22 cm,, and less than $\frac{6}{60}$. Mr. Jessop noted right eye, V $\frac{6}{0}$, 16 J. at 22 cm.

There is no swelling now of the lids, and the tension is normal. *Ophthalmoscopic appearances.*—Close to the inner side of the optic disc are three small hæmorrhages, the disc itself is paler on its inner side, and its margins indistinct; yellow spot slightly œdematous; vitreous clear. Pupil of same size as that of the left, and acts well to light and accommodation.

Left V $\frac{6}{12}$, 4 J. at 18 cm. + ·5 D. cy. $\frac{6}{9}$.

September 30. Mr. Jessop found only one retinal hæmorrhage remaining, and the margin of the inner side of the disc was more distinct. V $\frac{6}{24}$ 10 J. at 22 cm. Urine; no albumen, no sugar.

On October 14, I examined her and found V of the affected

eye to be $\frac{6}{36}$ and 14 J. at 18 cm. The field was taken on the perimeter, and found to be rather contracted at the outer part. The retina surrounding the disc was rather hazy, and at the upper edge of the optic disc slight swelling was shown by the occurrence of marked parallactic movement; no hæmorrhages; arteries a little diminished, and their sheaths slightly thickened.

On November 4, V was still only $\frac{6}{36}$, improved to $\frac{6}{24}$ with +2·5 D. cyl. I thought the disc was of a better colour, but the arterial sheaths were still conspicuously white. The other eye was nearly emmetropic (H. As. 0·5 D.), and had V = $\frac{6}{9}$.

In view of the considerably higher ametropia in the injured eye than in the sound one, it may be doubted whether the residual defect of the former was all, or even chiefly, due to the blow. The manner in which the woman described the sight returning first in the centre of the field was very graphic. A girl who had had temporary embolism of the central retinal artery, the plug afterwards moving on into one of its branches, described the return of her sight in almost the same terms as those used by this woman ("The Lancet," 1875, II, 491). In both cases the yellow spot was the first part to recover, because it is supplied with blood better than any other part of the retina; in the present case the temporary blindness was due to severe concussion, from which the best nourished part recovered first; in the case of embolism the re-opening of the main retinal artery took effect first on the part which contained the greatest number of blood-vessels.

Hæmorrhage beneath Retina at Yellow Spot from Straining.

A young man, William W., æt. 30, labourer, was unloading ballast from a barge into a cart, when he noticed a mist come over his left eye. Nine days later he came to Moorfields, in February, 1884. V of left = $\frac{6}{6}$ partly; that of right = $\frac{6}{6}$ well.

Several dark, well-defined blood patches were found at left yellow spot. The largest of them seemed to be exactly at the *fovea centralis;* it was prominent, and the reflecting surface of the retina was very visible in front of it; so that it must have been beneath the retina. On March 5 this large central hæmorrhage was smaller, and the lesser ones had almost disappeared. There was no history of injury; he was not liable to epistaxis, and the urine was normal.

Persistence or Relapse of Traumatic Hæmorrhage behind Lens.

Mary P., married, æt. 55, admitted at Moorfields Hospital, July, 1884. She had a blow from a fist on the right eye four years previously, and the eye had been nearly blind for eighteen months. Examination proved that with this eye she could now only see shadows; T.n., direct action of pupil bad; fundus quite dark; by focal light a thick roll of red blood was seen on the posterior surface of the lens near its border, perhaps contained in the canal of Petit? Left eye normal. Although we have no proof of the date when the blood seen on the edge of the lens was effused, the case is of interest as an example of either very long existence of a blood clot in the eyeball without decoloration, or of recurrence of hæmorrhage without repetition of the violence which presumably first occasioned it. She was only seen once.

Long continuance of Micropsia after Syphilitic Choroiditis.

Eliza R., a middle-aged woman, had iritis first in the right then in the left eye, with other symptoms of secondary syphilis, in the summer of 1880. Later on she had choroido-retinitis, causing defective sight. Vision improved, but in the left it never became perfect and remained worse at night. She came again in November, 1883, for conjunctivitis of the left. Vision of right was perfect $= \frac{20}{20}$ and 1 J.; vision of left $\frac{20}{40}$ and 4 J., with $-1{\cdot}25$ D. $= \frac{20}{20}$. She said that things still looked smaller with the left eye than with the right, and less clear. *Ophthalmoscopic examination.*—The left eye showed widely spread superficial atrophy of choroid; no change was visible in the right.

Condition Eighteen Years after Syphilitic Retinitis.

Anne C., æt. 52, married for twenty years, had good sight until a few days after her first confinement eighteen years ago. Her account is that her vision then failed suddenly as she was reading in bed; there seem to have been no variations of sight. She had no convulsions, or other symptoms of cerebral or renal disease As soon as she could get up she was led to an Ophthalmic Hospital, for she could not see to guide herself, and after three months' treatment got to see much better. Since then she has lived much in South America. For about seven years past the sight has again been gradually failing, but she has had no treatment; and the sight is now much worse at night than by day. When seen at Moorfields in July, 1884, she saw $\frac{6}{60}$ with each eye with her H. (6 D. in right, 3·5 D. in left) corrected; near V was not tested with glasses, but she was wearing + 3 D. In each eye there was a posterior polar cataract with spokes and separate rings of opacity; opacities in the vitreous; extensive choroidal changes often in the form of greyish patches evidently old deposits; diffuse haze of retina in the central region, and also of the optic disc; the haze of retina was partly in front of the vessels, partly behind them; the periphery of the retina was clear; retinal arteries small.

There was no history of syphilis in her husband, but the family history was extremely suspicious, and the eye-changes were very characteristic of syphilitic disease. It is probable that the woman had syphilis very shortly before her first confinement, and thus did not infect the fœtus, for the first child is living and reported quite healthy. The second child was born fifteen months after the first, and there were afterwards five others born, and two miscarriages. Of these six children born after her sight failed, three were dead at birth, and the other three died within three months, dwindling away.

The only other plausible suggestion as to the cause of the existing condition of this woman's eyes, is that it may have been the result of a very severe albuminuric inflammation. This is, however, on all grounds very improbable; she had no convulsions, she was not long confined to bed, and the eye-

changes as now seen were quite unlike those left as the result of renal retinitis even in its worst forms.

Syphilitic Iritis in an old Glaucomatous Eye.

Daniel B., æt. 45, labourer, had iridectomy performed on the right eye for "Glaucoma" by Mr. Lawson, at Moorfields, five or six years ago. He could not give much account of the character of the glaucomatous attack. He came to St. Thomas's Hospital on June 3rd, 1884, on account of double recent syphilitic iritis. The tonsils were ulcerated, and there were brownish blotches on the scalp.

There was nothing special in the characters of the attack; adhesions formed in both eyes, and in the left the iris was decidedly thickened, almost nodular. In the right, T. was slightly increased and the disc deeply cupped; there were large webs in the vitreous; V = fingers at 1′ in the centre of the field. V of left was also extremely defective, but this was accounted for by the state of the pupil.

He attended till the end of the year, taking mercury and iodide of potassium, and using atropine to the left. On one occasion for a few days in the course of the treatment, atropine was accidentally used to the right, and T. was increased to at least + 1, but was restored to normal by eserine in a few days. Numerous adhesions formed in the left, and some irregular of atrophy choroid was seen around the disc, at the last examination on December 15, the disc itself being normal. Although no glaucomatous symptoms appeared in this eye, iridectomy was advised as a precaution.

This case is of interest as showing that an iris, which was very probably somewhat atrophied from glaucoma, may take on acute inflammation from a constitutional cause.

Irido-choroiditis in one Eye during a Fever, accompanied by Symptoms of Meningitis.

(Notes by Mr. J. Hutchinson, Junr., and Mr. W. H. Jessop.)

George D., æt. 9 (p. 95), came to Moorfields in September, 1883. He had very good sight and hearing until four years old,

when he had "typhoid fever," from which he was in bed for four months; during this attack he was very delirious, and after recovery from the fever he was deaf and dumb and squinted with the left eye. Mr. Lyell tenotomized the left in rectus, and ordered him + 2·25 D. glasses.

Left eye now has many narrow bands of adhesion between deeper layers of iris and lens; pupil very irregular, but dilates considerably to atropine; small opaque spots on posterior surface of lens; in the vitreous, coming forward from the optic disc but not reaching the lens, is a white band with indistinct outline.

We have here, probably, a case of irido-choroiditis, caused by meningitis, one of the cases which, had it led to severer changes in the vitreous, might have somewhat resembled glioma.

Atrophy of one Optic Nerve after Papillitis from Erysipelas affecting Orbit during Convalescence from Scarlet Fever.

(Notes by Mr. F. W. Marlow.)

F. D., æt. 15, came to Moorfields Ophthalmic Hospital on March 5th, 1884. He was admitted into the Homerton Fever Hospital in November, 1883, for an attack of scarlet fever, and Dr. Burgess kindly sent the following note of the attack:— "F. D. did not have a severe attack of scarlet fever, but there was perhaps more pain than usual in the throat, though no evidence of extensive cellulitis spreading from the throat. About three weeks after admission, when he was able to get up, erysipelas of the left side of the face set in. There was pain near the angle of the jaw, but the redness and swelling was most pronounced about, and on the level of, the eye."

The swelling of the face lasted a week, and when the boy was able to open his eyes he found the left was blind; there had been no pain in the eye at any time.

The condition of the eyes when he came to Moorfields was as follows:—

R. (after atropine) V $=\frac{20}{50}$ + 2·25 D. $=\frac{20}{20}$: Optic disc, too

red, margins hazy, white lines along the vein going downwards, a crescent of exposed sclerotic downwards; no proof of papillitis.

L. has no p.l. Optic disc, pale, its substance hazy and its margins ill-defined, white lines along the vessels, which are of normal size; "no proof of past swelling, but there has certainly been papillitis."

The question in this case was whether the orbital cellulitis, which no doubt led to the destruction of the left optic nerve, had spread from the throat by way of the spheno-maxillary fissure, or had extended from erysipelas of the face. The latter, which is the more common event of the two, seems to have occurred in the present instance.

Single Optic Neuritis, ending in complete Atrophy during the delirium of fever (? Typhoid). Old Nebulæ and High Hypermetropia in both eyes.

(Notes by Mr. D. P. James.)

John B., labourer, æt. 26, was taken to the Homerton Fever Hospital on October 23, 1884, for what he calls "typhoid fever"; he became delirious shortly after, and on coming to himself a month later found that the sight of the left eye had quite gone; no change had occurred since then. There was no history pointing to orbital cellulitis. He said he was sure he could see quite well with the eye until his illness, and that the other (right) eye had not been affected in any way during the fever.

He came to the Moorfields Hospital on December 20th.

No history of syphilis, fits, lead poisoning, or injury, and there were no ataxic symptoms; family history very good.

Right.—With ophthalmoscope, H. about 10 D., choroid dark; disc normal; central corneal nebula; pupil equal to left: V $\frac{6}{36}$, + 8 D. $\frac{6}{18}$.

Left.—Central corneal nebula, causing irregular refraction, no direct action of the pupil; disc very white and opaque,

edge hazy, small defined patch of white opacity at upper margin; vessels about normal; hypermetropia about 10 D. No perception of light.

Two cases of severe Albuminuric Retinitis coming on during Pregnancy. Recovery of Health and Good Sight in both after miscarriage in one and artificial premature labour in other.

(Notes by Mr. G. D. Johnston.)

Case 1.—Anne S., æt. 29, was admitted under the care of Dr. Gervis, at St. Thomas's Hospital, in February, 1885; the particulars are given below. Shortly before she left the ward in March, Mr. Johnston and Dr. S. W. Sutton found severe, double retinitis, albumen having been found in the urine a few days before. She was complaining of some dimness of sight at this time.

On re-admission five months later I had the opportunity of examining her eyes after the œdema and exudations in the retinæ had passed away. The record of the appearances at the two dates adds to the value of the case.

Previous History.—Has had the ordinary illnesses of childhood. Had rheumatic fever when 14 years old, and scarlet fever when 16. Since her marriage at 16 has suffered greatly from sharp aching pains, passing from the frontal to the occipital regions, and is hardly a day free from these pains. Catamenia regular before marriage. Married at 16; eight pregnancies in 10 years. First child born three years after marriage, æt. 10, well now; was a transverse presentation. 2. Premature labour nine years ago, eighth month. 3. Premature labour, eighth month, seven years ago. 4. Miscarriage, fifth month, seven years ago. Since that time patient has had four miscarriages, all of which occurred between fifth and sixth months.

Mrs. S. was admitted to St. Thomas's Hospital on February 25th, 1885, under the care of Dr. Gervis, on account of loss of blood from vagina. She miscarried shortly after admission; a piece of placenta was retained; it was removed by Dr. Gervis two days afterwards. She had high temperature and offensive discharge for a few days.

March 10th. Temp. normal, P. 88. Patient feeling better, but still very anæmic.

March 13*th.* Complaining of almost continual headache and some dimness of sight, but not of high degree. Skin pale and pasty-looking: some slight anasarca about back and abdominal wall; some puffiness below the eyes.

Lungs.—Some deficiency of resonance at left base posteriorly, and a few râles to be heard at root of R. lung. Otherwise normal.

Heart.—Apex-beat in fifth space one inch external to nipple. No increase of dulness upwards or inwards.

Pulse 90, tense. Vessels thickened. Urine, sp. gr. 1015, turbid, some mucus. Albumen $\frac{1}{6}$. A number of vaginal epithelial cells and some amorphous phosphates. No casts.

March 15*th.* Eyes examined by Dr. S. W. Sutton.

R. O.d., very swollen and rather pale. Veins tortuous. At y.s., a large group of very small bright white dots, and around this some large patches, white and soft edged. Several hæmorrhages, mostly rounded in shape.

L. O.d. as in R. Many patches of white exudation, larger in size than those of R., scattered about y.s. region, and a few to inner side of o.d. No small white spots as at R. y.s. Hæmorrhages more numerous than in R.

She left the hospital on March 18th, and was re-admitted on August 10th, 1885, on account of a mass protruding from the os uteri, about the size of a hen's egg. This was removed and turned out to be a placental polypus. At this examination patient was found to have a bi-lobed uterus; there was also found the remains of a vaginal septum.

On August 18th, Mr. Johnston asked me to examine her eyes, and I made the following note:—

O.ds., very pale, retinal arteries diminished, a little haze of retina in many parts, and scattered small rounded black dots, sometimes lying upon bases of choroid paler than the rest. Group of fatty dots at each y.s.; more in R. The black dots tend to be grouped near large vessels at periphery, but are also scattered round each disc.

August 24*th.* Urine sp. gr. 1012, acid, albumen $\frac{1}{10}$. Deposit of granular hyaline and a few fatty casts. Some epithelium from urinary tract.

Case 2.—Jane D. (p. 135), æt. 40, married. Came to Moorfields in February, 1884. She was a stout florid-looking woman, in an advanced state of pregnancy, and said that she had suffered from severe frontal headaches, lasting four or five hours, from October to December, 1883, always accompanied by vomiting. Since December the headaches had stopped, but early in January a severe cough came on and her sight failed. She had been married 19 years, and had 10 children and three miscarriages; the eldest child was 17 years old and healthy; the youngest 16 months old. Her face, arms, and legs always swelled during pregnancy, but the eyes had never been affected before, nor had she suffered from headaches.

With the right eye she could on admission see only letters of 20 J., but with left she saw $\frac{6}{24}$. The ophthalmoscope showed severe papillo-retinitis in each eye; general haze and œdema, abundant soft white patches and hæmorrhages, bright white dots at yellow spot. All the symptoms more marked in right eye.

"The changes indicate that the duration of the disease is not less than two months, and point to its being still in progress." There was marked pitting of the legs; urine, 1005, acid, albumen about $\frac{1}{20}$th.

At Mr. Nettleship's suggestion, Dr. Julius Cæsar, her medical attendant, induced premature labour; turning had to be done for a breech presentation, but the child died from pressure on the cord.

The patient came again in a few weeks (March 26), looking in very good health. In both eyes the changes were clearing up, optic discs less hazy, and the vessels, especially the veins, smaller; towards the periphery numerous scattered black pigment spots, often surrounded by a narrow collar of whitish choroid; still numerous scattered soft buffy-white patches, and one large hæmorrhage in the right eye. Sight improved, especially in the left, as follows:—

$$V: \begin{matrix} R: 18\ J.\ \text{at}\ 8'' \ \text{and}\ \frac{1\frac{1}{2}}{60}. \\ L: 8\ J.\ \text{at}\ 8'' \ \text{and}\ \frac{6}{9}. \end{matrix}$$

On July 1st, 1885, she came much improved in health and

colour, and two months pregnant. Her vision was the same, and the note states (that in the left eye) there are abundant small white dots clustered between the optic disc and the yellow spot, and that for a long distance the sheath of the inferior macular artery is thickened by ensheathing white tissue: in the right eye, numerous scattered small white spots, and a small patch of thickening on a vein up and out from the optic disc. All the hæmorrhages had disappeared.

Rapid onset of Tobacco Amblyopia with Inflammatory appearances, and a Retinal Hæmorrhage in an intemperate Smoker, with Dilated Capillaries. Rapid Recovery. ? Influence of Snuff-taking.

(Notes by Mr. Marlow and Mr. Jessop.)

D. Cromartie, æt. 54, clerk, a tall, robust, florid Scotchman, with acne rosacea, came to Moorfields on May 17th, 1884. His sight had failed rapidly in both eyes just a fortnight before; he said that on getting up one particular morning he found that he could not see to brush his hair, and that he could not read. On being asked, he said that people's faces looked pale, that he saw better in a dull light, and that he confused copper with silver. Visual acuteness was exactly the same in each eye, $\frac{20}{0}$ and 20 J. barely with +3 D. There was a well-marked central scotoma for red and green—densest outside the fixation point. *Ophthalmoscopic examination.*—Optic discs much too red, margins hazy and striated; to the inner side of the left disc, lying just below an artery of considerable size, was a well-marked linear hæmorrhage in the retina: there were no other hæmorrhages in either fundus. He had smoked since he was a boy; for thirty or forty years he had smoked 2 ozs. of cavendish a week. He habitually drank a good deal—taking rum, brandy, and sherry; ale gave him diarrhœa. The urine contained neither sugar nor albumen. He was told to leave off smoking, to wear neutral-tint glasses, to apply a series of blisters to the temples, and to take nux vomica with an occasional purge.

On June 7th vision had improved to $\frac{20}{70}$, and with +3 D. he read 2 J. fairly. The hæmorrhage in the left was still visible,

but much faded; optic discs paler and less hazy; the right disc was clearer and paler than the left, and on its upper and outer part were some loops of very small dilated vessels. The left disc besides being less clear than right, shows marked white thickening of the sheaths of its descending artery and vein.

On July 5th R. V = $\frac{20}{50}$, H.m. 0·5 D. = $\frac{20}{40}$, L. V = $\frac{20}{30}$, not improved by glasses. With both eyes together he reads 1 J. with +4 D. *Ophthalmoscopic examination.*—The two discs were now less alike; the *right* was very pale on its outer third—this pale segment being sharply marked off; the patch of small dilated vessels was still present just above the upper edge of the pale part: the *left* disc was rather hazy, and pale all over, unlike the right.

He had almost entirely given up tobacco, but still smoked two cigarettes a day; he had continued to drink as much as—indeed he said more than—usual during the whole of his attendance. It came out on enquiry that a fortnight before his sight failed, having a bad cold, he took snuff largely for some days, and it is possible that this may have been the exciting cause of the attack.

Recent Tobacco Amblyopia affecting one Eye earlier and more severely than the other. Retinal hæmorrhage in the Eye last attacked. Recovery. Patient a Teetotaller.

(Notes by Mr. W. E. Cant, F.R.C.S.)

John C., æt. 40, applied at the Moorfields Hospital on the 16th of August, 1885, stating that the sight of both eyes was failing, the left having begun six weeks previously, and the right more lately. He had hitherto had very good sight. Except that he could see better in the dark than by full daylight, there was nothing else to note about the defect of vision. He was a labourer in good health, and had had no other symptoms. He smoked 2 ozs. of twist tobacco a week, and had been a teetotaller for the last ten years. No history of syphilis or other constitutional disease. The urine, tested a few days later, was acid, clear, and free from both albumen and sugar.

State of Eyes on Admission.—Right, V $\frac{6}{18}$ and 6 J., not im-

proved by any glass, pupil normal, slight My. by ophthalmoscopic measurement. Defective perception of red extending from fixation point for about 15° to its temporal side; this defect was but slight at the fixation point, but was more marked a little to the outer side. The optic disc was rather misty, and a single *linear hæmorrhage of moderate size was seen near the disc* passing downwards and outwards. *Left*, V $\frac{6}{60}$ and 16 J., not improved by glasses; refraction myopic as in right; pupil smaller than in right, but normal. A large central scotoma for red of greater density than in right. Optic disc rather misty, but notably paler on the temporal side than that of the right eye; no hæmorrhages.

Some strychnia was prescribed, and he was told to leave off smoking.

On November 21st, visual acuteness had improved in the right to $\frac{6}{9}$ and 1 J., and in the left to $\frac{6}{12}$ and 6 J. The retinal hæmorrhage in the right had disappeared, but the discs had not changed in aspect; the left being paler than natural, especially on its outer side, and slightly veiled; the right of fuller colour, and rather more veiled. He had almost ceased smoking, but still took a pipe occasionally.

Central Amblyopia in a Smoker suffering from Diabetes.

(Notes by Mr. Napier.)

Alfred M. (p. 217), shop assistant, æt. 31, came to Moorfields on April 11, 1885. He was a spare-looking man, with thin and somewhat sallow face. He had been quite well till March, 1883, when he had pains in his loins, and general weakness. He attended under Dr. Wickham Legg at St. Bartholomew's Hospital, for diabetes, from November, 1883, to January, 1884. Two months before I saw him the sight of both eyes began to fail, and had been getting worse ever since—everything looking hazy. He said that he preferred full daylight to dusk, and that everything seemed to go black about twilight. He had smoked for about ten years, and used to smoke pipes a great deal three years ago, but for the last year, as pipes made his tongue dry, he

had only smoked three cigars a week, and sometimes none at all. He had drunk moderately, never excessively, sometimes spirits, but chiefly beer. Had gonorrhœa four years ago. His father and eldest brother have gout; no relative suffers from diabetes or phthisis.

On admission:—*Right*, V = 18 J. at 12 cm., and not $\frac{6}{60}$. *Left*, V = 16 J. at 12 cm., and not $\frac{6}{60}$. Pupils:—*Right*, 3·5 mm., action slow, and it remains smaller than left during accommodation. *Left*, 4 mm., action normal. Well-marked central scotoma for red in each; field for red contracted. *Ophthalmoscopic examination:*—Right disc paler than left; no retinitis or cataract. Urine, 1032, acid; no albumen, but a good deal of sugar. Knee jerks absent.

August 8. Sight about the same. *Right*, $\frac{4}{60}$ 16 J. at 22 cm. Hm. 1 D. $\frac{6}{60}$. *Left*, $\frac{3}{30}$ 16 J. at 22 cm.; not improved. Urine, 1035, acid; sugar still present in considerable quantity.

November 25. Health much better, but has a cough and has been spitting blood; is still carefully dieting himself. Urine sp. gr. 1030, no albumen, but still contains much sugar. Knee jerks absent. Pupils rather large, and act only slightly to light, the right being, as before, always smaller than left. His sight has improved a good deal:—

Right, V $\frac{6}{18}$, Hm. 1 D. $\frac{6}{12}$; reads 4 J.

Left V $\frac{6}{18}$, Hm. 1 D. $\frac{6}{12}$; reads 4 J.

Myopia from Childhood. Rapid increase, soon after Marriage, to almost total Blindness. Question of Myopic Choroiditis.

Frederick R. L., now 51, a schoolmaster, has been short-sighted since he was a boy, but his sight kept very good until he married at the age of 35. Within six weeks from his marriage he began to have confusion in reading, the right eye getting worse than the left. Two years later, being by this time able to see very little with the right eye, he consulted Mr. Windsor

at Manchester, and says that the diagnosis was "atrophy of the choroid." His sight has continued to get steadily worse in both eyes. For the last eight years he has not been able to read print, but until a few months ago he managed to carry on his teaching chiefly by black-board work. He showed us some spectacles which he had had for several years, they were — 8 D. On examining with the ophthalmoscope, myopia of about 18 D. was found in each eye, with very extensive choroidal changes exactly alike in the two eyes; the central region of the choroid (including the yellow spot and the whole of the circum-papillary area), was completely atrophied with scarcely any pigmentation; but towards the equator this appearance passed into that of closely aggregated round patches of somewhat less complete atrophy, associated with a good deal of pigmentation. The peripheral changes were, indeed, exactly like those caused by syphilitic choroiditis.

Notwithstanding the entire absence of choroidal tissue for some distance around the disc, the disc itself and the retinal vessels looked quite healthy.

The rapidity with which the sight failed in this patient certainly seems to favour the prevalent doctrine that the choroidal atrophy accompanying myopia is, or at any rate may be, the result of a preceding choroiditis. This view was favoured by the great accumulation of pigment towards the border of the diseased region. On the other hand it is difficult to understand how an active, even if sub-acute, choroiditis, if severe enough to end in complete absorption of every trace of choroidal tissue, could take place without the inflammation being communicated to the optic disc and retina. A patch of syphilitic choroiditis close to the disc almost always gives rise to simultaneous papillo-retinitis leading to some atrophy.

Of much interest also is the occasion which seems to have exercised so serious an influence on the nutrition of this patient's sclerotic and choroid. I could not make out that he worked harder after marriage than before; he assured me that he was comfortably off, and that his work

continued to be of the same kind and amount as it had been, still he was perfectly definite in his statement as to when the failure began. I questioned him as to syphilis, and found no reason to think that he had suffered from it. I forgot to ask him whether any of his kinsmen were shortsighted.

Unsymmetrical Nystagmus in three Hypermetropic Brothers; the same Eye affected in all. Strabismus following the Nystagmus in one.

Michael G., came to Mr. Wordsworth on January 31st, 1883, for convergent strabismus, and after atropine + 4·5 D. spectacles were ordered for constant use. He was then aged 7.

March 4, 1885. His mother says that before the squint came on the left eye "danced," just like the other two sons'; the "dancing" lasted off and on for many months, and then gave way to the squint. Has no squint now with the glasses, but the left eye squints inwards as soon as the glasses are taken off.

Lewis G. (p. 206), came to Moorfields in January, 1883, under the care of Mr. Wordsworth, for slight ophthalmia after measles, and was noticed to have nystagmus of the left eye. On July 15th following, the note is: "Has no nystagmus now."

March 4, 1885. Has no nystagmus or squint; he is liable to fits, during which he turns "black in the face" and loses consciousness, the last one was nine months ago. Age not stated, but he was between the other two brothers.

Percy G., æt. 14 months, came to Mr. Nettleship at Moorfields on Feb. 25th, 1885. He had lateral, moderately quick nystagmus of the left eye, which had been first noticed only three days before. He is a healthy, quiet child, and has had whooping cough, mumps, and one fit when three months old. The mother said the right eye did not "dance;" I thought that it once or twice oscillated a little, but at the most this was doubtful.

March 14. The nystagmus is as before. There is H. about 3 D. in each eye; fundus healthy.

Unsymmetrical Nystagmus with Rhythmical Movements of Head and corresponding Arm, beginning at the Age of Six Months.

George T., æt. 15 months, was sent for examination by Mr. Godlee on Feb. 18, 1885.

When 6 months old, "working" movements of the left eye, head, and left arm, were noticed, but lately the movements of the left arm had ceased. On waking the eye is still for twenty minutes, and then the movements commence again.

The left eye now shows a constant, quick, small, lateral nystagmus; pupil acts to light well, and also acts at times when the right one does not; the right pupil is often larger than the left. There is a constant, slow, rotatory shaking movement of the head, but it is much slower than the oscillations of the eye.

He seems to see equally well with each eye.

Central Choroido-retinitis in one Eye, probably caused by Exposure to Sunlight.

J. F. U., an excise officer, æt. 34, came to Moorfields on July 27, 1885, stating that when shooting at Wimbledon in the hot sun during the previous week, he had noticed that in the evenings everything looked reddish with the left eye, and also that he did not shoot well in the mornings. Two days after returning from Wimbledon, he found that a "dark spot" came over his left eye.

There was no history or evidence of syphilis. Vision was on admission almost, if not quite, equal in the two eyes; with each he read 1 J.: media and fundus normal.

Ophthalmoscopic Examination.—In the *right*, the media and fundus were normal. In the *left*, the yellow spot region was darker than in the right, and several small pigment collections were seen lying upon palish spots about the circumference of the yellow spot, together with very fine whitish stippling about the *fovea centralis*. He was ordered smoked domed glasses.

On August 26th the ophthalmoscopic changes were the same.

Notwithstanding the asymmetry of the disease, the exposure for some days to powerful sunlight seems the most probable cause of the disease.

Congenital Defect of Sight; Marginal Thickening of Cornea; Nystagmus.

R. R., æt. 35, has always seen very badly, and he has rotatory nystagmus. The palpebral fissures are set obliquely upwards and inwards. With the right eye he can only see the hand moving at 18″; the iris of this eye is tremulous. The left sees 10 J. at 2″ or 3″, and counts fingers at 2′, not improved by glasses. Pupils measure 1·5 mm., act but little to light, and dilate very little to atropine. The margin of the cornea in each eye is covered all round by a superficial, hazy, raised zone, as if the conjunctiva had encroached beyond its natural limits; it is broader and better marked in the left eye than in the right. The fundus could be well lighted by the ophthalmoscope, but no details were visible owing to the oscillation.

ON SYMPATHETIC INFLAMMATION OF THE EYEBALL.

By R. Marcus Gunn, M.A., M.B.,

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The following cases were under my care while House Surgeon at Moorfields, and they are now published with the kind sanction of those of my colleagues to whom they belonged. For the valuable pathological notes incorporated in this paper I am indebted to Dr. Brailey, who examined the eyeballs while Curator of the Museum.

Case I.—*Penetrating Wound of Globe followed by Severe Sympathetic Inflammation twenty-four days later. Excision of Injured Eye three days after Commencement of the Inflammation. Steadily Progressive Destructive Ophthalmitis soon leading to Ciliary Staphylomata, and Shrinking of Cornea with Diminished Tension. Excision of Second Eye at Patient's Request.*

Edwin J., æt. 24. Admitted November 29, 1876.

Right eye injured four weeks ago by a fragment of steel. There is a wound in the lower sclero-corneal junction with large prolapse of iris. No anterior chamber. Iris discoloured.

Left eye. Sight became dim three days ago. Next day pain commenced and has continued ever since. There is now severe iritis with much ciliary injection. V = bare perception of large objects.

Right excised. (The piece of steel found in lower part of vitreous.)

Treatment.—Iodide of potassium, cinchona, calomel and Dover's powder. Mercurial inunction to slight salivation, and stimulants. Gutt. Atrop. gr. 4 ad 1 oz. frequently. Great pain and much sleeplessness during stay in hospital, relieved temporarily by subcutaneous injections of morphia. Dec. 11. Bare perception of light. Jan. 7, 1877. Small ciliary staphylomata have been developing themselves during the last few days.

13. The ciliary staphylomata have become much larger, especially above: two of them pricked with fine needles. Feb. 8. The upper staphylomata are now larger than the cornea: the latter is much smaller than before. They have been repeatedly pricked lately. Pain not severe, and now only occasional. Doubtful perception of light. Discharged.

March 2, 1877. Re-admitted. The eye has been painful for the last week. Globe enlarged and much deformed by irregular ciliary staphylomata. No perception of light. — T. 1. 3. *Left* excised at his own request. 14. Discharged.

Pathological Examination.—Right eye:—globe somewhat enlarged, measuring 26·5 mm. antero-posteriorly, 27 mm. laterally, and 26 mm. vertically. T. +. Cornea clear. Iris greenish. No anterior chamber. At the lower inner sclero-corneal junction is a bulging, formed by a tough protrusion of thickened iris covered with lymph. *Equatorial Section:*—Retina detached and contracted, with numerous blood-clots firmly adherent to its outer surface. Choroid *in situ;* the space between it and the retina is filled with dark red liquid blood. This subretinal space is traversed by a long firm band of tough lymph, pointed above where it adheres to the choroid and sclerotic at upper part of globe, and thicker below where it springs from the upper part of the partially contracted retina. The upper part of the retinal cavity is occupied by firm, translucent, comparatively unaltered vitreous. The rest of this cavity is filled by a deep-yellow purulent mass in the lower part of which (or just behind the ciliary processes) a long scale of metal is embedded. The choroid appears normal; sclerotic slightly thickened. Lens absent. An *antero-posterior section* of the anterior half shows the ciliary body enormously thickened, tough and greyish translucent with an irregularly scattered line of pigment bearing on its inner surface a greyish-yellow purulent substance like that enclosing the foreign body a little further back.

Left eye:—Globe measures 27 mm. in its antero-posterior, 24 mm. in its lateral, and 23 mm. in its vertical diameter. — T. 1. The cornea is embraced in its upper inner two-thirds by a long narrow staphyloma, greyish in colour and slightly soft. Cornea itself is rather small, with translucent centre, through which the outline of the pupil is dimly visible; its margin is

hazy with ramifying blood-vessels. Except at the staphyloma the sclero-corneal junction is very much depressed as if tied in. Vitreous entirely absent, and its place occupied by serous fluid. Choroid tough, grey, gelatinous and enormously thickened (from 2 to 2·75 mm.): it is lined by a thick, irregular, not very black pigment layer. Inside the cavity of the choroid the retina is lying in close contact with it upwards, inwards, and downwards, but is disposed in loose folds on the outer side.

Case II.—*Old Penetrating Wound of Globe. Recent Pain and Inflammation followed by Sympathetic Inflammation about two months later. Excision of Wounded Eye fourteen days after Appearance of Sympathetic Inflammation. Iridectomy a few days later. Destructive Inflammation.*

Allen D., æt. 23. Admitted Feb. 3, 1877.

Right eye injured three and a half years ago: penetrating wound of cornea from piece of iron about the size of a hazel nut. A fortnight later he lost the sight of this eye entirely, but it remained quiet till eleven weeks ago, when it became red and painful. There is now a small central leucoma in cornea with blood-vessels running up to it. Iris indistinct and very dark. Pupillary area opaque. There is a small dark staphyloma in the sclerotic just outside the corneal margin, slightly to the inner side of the median line below.

Left eye first felt an uneasiness fourteen days ago. Since then there has been dimness and much pain. There is now iritis with considerable ciliary injection and photophobia. Pupil irregular from posterior synechiæ.

Right excised. (No foreign body found.) *Treatment.*—Quinine, mercurial inunction to slight salivation. Heurteloup's leech to temple when pain severe. Gutt. Atrop. gr. 4 ad 1 oz. frequently. 14. Pain continues to be severe. + T. 2. Iridectomy done down and in. 15. Pain relieved. 19. Anterior chamber reformed. Aqueous clearer. No pain. T.n. Slight tendency to bulging at site of iridectomy. 25. Has had pain for the last two days, especially severe at night. 26. Anterior chamber gone. More ciliary bulging, less pain. The ciliary bulging continued to increase with little pain until March 23, when he was discharged with doubtful bare perception of light.

Feb. 26, 1878, he writes to say that his eye feels strong, but that he can only distinguish light from darkness.

Pathological Examination.—T. slightly —. Cornea flattened. Globe of normal size except that its antero-posterior diameter is diminished. Staphyloma in lower inner equatorial region and another smaller one to the inner side and 6 mm. in front of the *optic disc*. Vitreous shrunken to about one-fourth its normal size, taking the retina with it. The posterior part of the retina is tubular, the lower border of the tube being connected with the choroid below by tough, translucent, stretched tissue, apparently fibrous in structure. In the equatorial region the retina is closely adherent to the choroid at certain points, between which are intervals where it is detached and shrunken into folds, giving it a sacculated appearance on section. The retina evidently exercises considerable traction on the choroid and sclerotic where these adhesions exist; this is seen especially at the optic nerve entrance, which is drawn well forward and the adjacent choroid much thickened (possibly by the mechanical traction). From this point the choroid thins off gradually in front till it is of about normal thickness near the equator; at the staphylomata, however, it is very thin. The anterior surface of the iris is covered with a closely applied layer of greyish, semi-translucent lymph, which is closely adherent to the posterior corneal surface. The posterior surface of the iris adheres to the remains of the shrunken lens-capsule. Blood-clots are found in the anterior and posterior parts of the retinal cavity. The vitreous is represented by a small quantity of opaque tough tissue. On the ciliary processes and extending to their apices is a layer of hard substance that cuts like cartilage. The pigment epithelium lining the choroid is dark and somewhat irregular. At the staphylomatous bulging a thin greyish layer is found on their internal surface, and at these points the choroid is very closely adherent to the sclerotic. Dr. Brailey remarks:—"There has been irido-cyclitis with development of fibrous tissue in the anterior part of the vitreous cavity; also some spots of choroiditis and adhesion of these to retina. Some spots apparently of old inflammation where choroid and sclerotic have passed into atrophy, and are closely adherent. Great traction on posterior part of globe. No foreign body."

Case III.—*Lost Inflamed Eye followed by Sympathetic Inflammation. Excision six weeks later. Destructive Iritis in Sympathising Eye.*

Henry C., æt. 34. Admitted April 28, 1877.

Left eye lost "from being poisoned by the bite of a grey fly like a mosquito, but larger," in the Island of Ceylon about six months ago. This eye was excised elsewhere about six weeks ago.

Right eye. About three months ago he noticed dimness in this eye. The sight gradually grew worse without pain for about three weeks, but then it became painful. The vision was as bad as it is now before removal of left. Now the iris is bulged forward, thick and very vascular. Pupil closed. Bare light perception. T.n. Occasional pain. Ordered belladonna fomentation, Gutt. Atrop. gr. 4 ad 1 oz., and quinine internally.

He states that about two days after the fly-bite he lost the use of the corresponding (left) side of his face, and deafness began in the left ear. He is now very deaf; can just hear the watch on contact in the right and not at all in the left ear. Tuning fork heard indistinctly on both sides. Membranes look slightly thick but are otherwise normal.*

May 17. He thinks his sight is better. Advised to return in about a year; sooner if in much pain. Discharged.

Case IV.—*Old Lost Globe from Perforating Ulcer. Sympathetic Inflammation about thirty-nine years later. Excision. Improvement.*

James C., æt. 39. Admitted June 13, 1877.

Left eye lost from ulceration shortly after birth, probably ophthalmia neonatorum. Old perforation with extensive anterior synechia now bulging considerably. T.n. Bare perception of light.

Right eye has occasionally seen muscæ for some months past.

* The entire seventh nerve seems to have been affected, both portio dura and portio mollis. May the deafness be due to past sympathetic inflammation of the middle or internal ear? Or is there any connection between the affection of either seventh nerve and the inflammation of the injured eye?

Has now iritis of about eight days' duration; posterior synechia below; pupil sluggish. Anterior chamber deep. T.n. Slight pain and dimness.

Left excised. Mercurial inunction and strong atropine drops. 15. Pupil now well dilated; posterior synechia has given way. July 18. V = $\frac{20}{50}$ not improved by spherical glasses. Eye looks quiet. To continue atropine. Discharged.

Re-admitted Sept. 14. Complains of pain down the nose and at inner canthus on right side. Slight swelling of upper lid at inner canthus. Conjunctiva injected. Ordered atropine drops to eye, and iodide of potassium and chloral hydrate in mixture. A few days later pupil was widely dilated. Anterior chamber large and deep. V = $\frac{20}{70}$ about, better in morning and worse as the day goes on. Atropine now discontinued. 24. V = $\frac{20}{40}$ Hm $\frac{1}{36}$ = $\frac{20}{20}$ (letters). Eye feels easier. Discharged.

Examined on Feb. 27, 1878. Lids still swollen and irritable. Much mistiness and lacrimation at times, worse in gas-light. Occasional pain in the eyelids and at inner canthus, also over the orbit and in the temple. Subconjunctival vessels large. Ciliary injection. Numerous minute dots on posterior surface of cornea. Pupil active. T.n. Sight still weak; occasional attacks of dimness lasting for some time. Media hazy. Optic disc rather injected. V = $\frac{20}{30}$ fairly. Hm $\frac{1}{30}$ = $\frac{20}{20}$ partly.

Pathological Examination.—Antero-posterior and lateral diameters slightly increased. Vitreous fluid. Retina and choroid *in situ*. Optic disc deeply cupped, its blood-vessels small; it is surrounded by a ring of atrophy, much wider down and out. The iris appears as a black layer on the posterior surface of the cornea, and is stretched and greatly thinned. A scale attached to the middle of the iris probably represents the remains of the lens, and towards this the apices of the ciliary processes are greatly stretched and elongated.

CASE V.—*Operation on Lost Globe. Severe Sympathetic Ophthalmitis about ten weeks later. Excision of Exciting Eye fourteen days after Sympathetic Symptoms. Iridectomy Attempted two months later, and Lens Extracted after other two months. Iridotomy eight months later. Result Bad.*

Emily G., æt. 15. Admitted Jan. 11, 1877.

Right eye. Dense leucoma of cornea. Bare perception of light. Result of ophthalmia neonatorum.

Left eye perfectly sound.

Right. 12. Part of surface of leucoma sliced off from outer and upper periphery and from near centre with a bent broad needle. Central disc of corneal tissue removed by trephine and shrunken remains of lens removed through the opening: vitreous presenting. 13. R. E. no pain. Has perception of light. 14. There is now an opaque white film forming over trephined area. 16. R. E. — T. 1. The opening in cornea filled with soft opaque substance of new formation. No irritation. 18. — T. 1. The newly-formed substance now projects. Feb. 8. Discharged.

Re-admitted June 8. R. E. Globe now considerably shrunken, with large vessels running down in a leash to the trephined spot. It has been painful since last visit. L. E. about fourteen days ago this eye became painful, and the sight dim. Pupil small; many posterior synechiæ; dilates irregularly under atropine. Iris velvety. Marked ciliary injection. + T. 1? R. E. excised. Ordered strong atropine drops, and dark bandage. 18. Much *in statu quo*; she says sight is more dim. 29. Less injection and less pain for last few days. Discharged.

Re-admitted Aug. 21. The eye began to be painful again about fourteen days ago. Cornea hazy; slight ciliary injection; iris velvety; pupil irregular. + T. 2. Ordered Gutt. Atrop. and dark shade. 22. Iridectomy attempted upwards, no iris could be obtained either with blunt hook or forceps. 26. A little blood in anterior chamber. Sept. 2. Slight pain last night. Blood now absorbed. 12. T.n. No pain. Counts fingers barely at one foot. Pupil occluded and excluded. Iris bulging forwards making a. c. very shallow. Sight rather better than on admission: "the thick fog has nearly gone away." To have dark glasses. Discharged.

Re-admitted Oct. 12. Cornea looks small. Pupil closed, immovable under atropine. Iris bulged forwards. No a. c. Bare perception of light. + T. 1? 18. Has had occasional shooting pain over top of eyeball, relieved temporarily by Heurteloup's leech. 23. Linear corneal incision above; iris snipped at either extremity with Wecker's scissors. Lens removed nearly entire. The iridectomy was then easily completed. 27. Eye watery with occasional pain. Nov. 4. No pain now. Lymph gradually filling coloboma. Bare perception of light. 7. Pupil and coloboma nearly filled with lymph. 12. T full. Slight aching pain. 13. A little effusion of blood in pupil. Globe very tender to touch. T.n or slightly —. 23. Much pain occasionally in right orbit. Had slight aching in left eye yesterday. 26. Eye was again painful at intervals during yesterday; better to-day. Dec. 6. Complains of pain shooting between the two orbits, relieved by warm bathing. 10. Coloboma full of lymph, partially vascular. T.n. Iris in contact with cornea. Bare light perception. Large vessels run down through cicatrix into anterior chamber. No pain. Iris vascular. Discharged.

Re-admitted June 14, 1878. Eye is quieter now, and the sclerotic conjunctiva is of normal vascularity except above, where conjunctival vessels run into the corneal cicatrix, and form a vascular plexus on organised lymph in the pupil. Globe somewhat shrunken. — T. 2. Anterior chamber absent or very shallow. V = bare perception of light. Since last discharge she has had occasional pain in the eye, occurring every few days and lasting for about a day; it is relieved by warm bathing. She has had headache, pain shooting from the vertex to across the forehead or *vice versâ*. June 18. Iridotomy from inner side. No gaping occurred. A little iris pulled out piecemeal by forceps after repeated trials. 28. V as before. July 17. V unchanged. No appreciable pupil remains from the operation. Discharged.

Pathological Examination.—On *equatorial section* the retina is soft, wrinkled, and lies loosely in position, and a yellow serous fluid escapes from its cavity. The ciliary processes are much thickened, and are entirely covered with a greyish-white, tough layer. The choroid is thickened over a considerable part of the outer wall, and possibly slightly so over the rest of the globe.

The iris is somewhat thickened and is closely adherent to the cornea; the pigment of its posterior surface is irregularly scattered and bears a fibrous layer on its posterior aspect.

CASE VI.—*Rupture of Ciliary Region from Blow. Sympathetic Ophthalmitis five weeks later. Excision. Partial Recovery.*

James F., æt. 58. Admitted March 13, 1877.

Left eye. Globe ruptured three weeks ago by blow from a cow's horn. Lens dislocated beneath conjunctiva in upper inner ciliary region. Margin of iris detached at outer side. Blood in anterior chamber. Ordered Heurteloup's leech and belladonna. 30. Severe pain last night preventing sleep. 31. No pain now. April 2. *Right* eye. Injected. Sight misty. No pain. April 3. *Right.* Pupil inactive. Ciliary injection. Posterior synechia seen under atropine. $V = \frac{20}{nil.}$. Jaeger 20 at 10″. *Left* excised. Strong atropine drops to right. April 27. Sight has slowly improved, and the synechiæ have all yielded except one. Discharged.

Examined on Feb. 22, 1878. Slight ciliary redness. Posterior synechia below. Stellate opacity in middle of anterior capsule? lymph. T.n. Has occasional severe pain in inner supra-orbital region. $V = \frac{20}{70}$ H $\frac{1}{30} = \frac{20}{50}$, and with reading glasses he reads Jaeger 6.

Pathological Examination.—There is a swelling with thickened conjunctiva over it at the upper and inner side of the cornea, the margin of which it just overlaps. The iris is detached at its ciliary margin furthest removed from the seat of rupture. The anterior chamber is deep with some hyphæma. There is a large arcus senilis especially below. T. slightly—. Iris greenish in colour and velvety, but not dull. The swelling consists of lens, apparently in its capsule, beneath thickened conjunctiva. It escaped through a rupture exactly at the sclero-corneal junction, but the opening now appears to be closed with tissue not unlike the thickened conjunctiva over the lens. The iris has a greyish exudation on its posterior surface. The ciliary body and anterior part of the choroid is thickened all round, and there are remains of blood between it and the sclerotic.

Case VII.—*Cataract Extraction (Graefe) with Entanglement of Iris in Cicatrix. Destructive Sympathetic Inflammation about four months later. Excision of Both Eyes.*

Charlotte C., æt. 57. Admitted April 19, 1877.

Left eye. Cataract extraction (Graefe) here in March, 1876; iris entangled in wound at operation, and remained adherent to cicatrix. On discharge then V c + 3″ = $\frac{20}{70}$; c + 2″ = J. 10. After going home she "caught cold," and the eye inflamed. Shortly afterwards (in August, 1876) the right eye became inflamed. The condition now is:—

Left. Cornea semi-opaque all over; a. c. very shallow; pupil drawn upwards and quite closed; iris velvety. — T. 3. No perception of light.

Right eye. Cornea slightly opaque; a. c. very shallow; pupil closed; iris velvety and vascular. — T. 1. No perception of light.

She has still pain in both occasionally, worse in right.

27. There have been several severe attacks of pain in and around the right orbit; *right* excised. May 8. The *left* eye has been painful for the last week; excised to-day. Discharged May 17.

This case is given by Mr. Morton in Reports, Vol. IX, p. 337. The increased tension there noted was present in July, 1876. By some mistake the right eye is mentioned as having been then excised.

Pathological Examination. — *Right* eye. Globe slightly shrunken; cornea small, especially in vertical diameter. *Equatorial section.* Vitreous absent, and replaced by a thin, yellowish fluid; retina loosely *in situ.* There are numerous plates of cholesterin in the retina and between it and the choroid. Lens small and *in situ*, adherent to posterior surface of iris; the latter is greatly thickened and in contact with, but not adherent to the cornea. The ciliary body is considerably thickened; this thickening extends 7 mm. backwards into the choroid, becoming less gradually up to this point.

Left eye. Globe rather small (but less so than right) and squared. T. —. Cornea of normal transverse diameter

(11·5 mm.), but only 8·75 mm. in vertical: it is clear. Iris is situated close to posterior aspect of cornea; its front surface appears very finely honeycombed, with close, whitish-yellow deposit on it. Pupil not visible, ? drawn up or closed. *Equatorial section:*—Retina has umbrella-shaped detachment, soft, and greyish-white. Its posterior part is cord-like; its anterior part is semi-contracted—nothing noted in its cavity. Between retina and choroid are abundant cholesterin crystals. Choroid *in situ*, of a light buff colour, finely mottled with pale-brown pigment dots formed by enlarged and altered epithelium cells. *Vertical section of anterior half of globe:*—Iris is apparently considerably thickened; it is adherent to the cornea, greyish in colour, and slightly gelatinous-looking on section. The ciliary body is also thickened, but this condition does not appear to extend into the choroid.

Case VIII.—*Cataract Extraction followed by Iritis. Secondary Operation two months later. Severe Sympathetic Inflammation about ten weeks after Extraction. Excision of Sympathising and Retention of Useful Vision in Exciting Eye.*

William G., æt. 62. Admitted May 31, 1877.

Left eye. Modified Graefe extraction here last March; lens came away well. Considerable infiltration of edges of wound followed; healing slow, with iritis. There is now thick opaque membrane in the pupil, which is somewhat drawn up. An incision made to-day from below with a broad needle, preparatory to an iridectomy. The needle cut a small hole in the lower part of the opaque membrane, which gaped from bulging forward of a bead of vitreous, forming a good round pupil: it was therefore left till the visual result should be ascertained. June 2. V not improved by operation. Discharged June 11.

Re-admitted June 26. Shortly after going home the *right* eye became red and painful, and has continued so ever since. There is now much ciliary and sclerotic injection. Pupil very irregular under atropine; many posterior synechiæ. In great pain sometimes. *Left* eye. Sight more dim for last day or two. No acute inflammation. Ordered hot belladonna fomentation, Gutt. Atrop., mercurial inunction, Heurteloup to temple, and quinine internally. The severe attacks of pain continued, occurring at inter-

vals of about a week, and worse during the night; generally relieved by Heurteloup. Had one very severe attack of pain lasting several days, not relieved during that time by any treatment. August 26. Slight salivation; no material improvement in eye. September 3. Much pain in right ear and in vertex. 13. Excision of right advised. 17. Continued pain in eye and head. *Right.* Iridectomy attempted downwards; only a small piece from pupillary margin obtained. 20. Pain has been more severe since operation. *Right* excised. 28. *Left* V c + $2\frac{1}{2}''$ = J. 20 at 5″. Discharged.

Re-admitted May 29, 1878. *Left* eye. Slight conjunctival and tinge of ciliary injection; no pain nor tenderness. T.n. Pupil as before. 30. Iridectomy down and in; good coloboma left; slight bleeding. June 4. Small clear space near outer periphery of coloboma; remainder covered by membrane. V c + $3\frac{3}{4}'' = \frac{20}{200}$ barely, not improved by cylinders; c + $2\frac{1}{4}''$ spells J. 16, slowly. Discharged June 6.

Pathological Examination.—T. —. Globe of normal size, and sclerotic of about average thickness; no anterior chamber. There is an artificial coloboma below, partly filled with loose pink lymph. *Equatorial section.* The place of the vitreous is occupied by a thin yellowish fluid. Retina and choroid *in situ.* Optic disc slightly hazy and its blood-vessels small. The lens is cataractous, and is almost concealed from behind by a white, semi-opaque, rather pearly-looking layer of lymph, thinner near the lens periphery; but in this latter situation there are some more or less isolated whiter nodules of the same character. The ciliary processes, especially their anterior parts, are covered with dirty whitish-grey, rather flocculent lymph. This latter forms a well-defined layer to the outer side, but extends inwards for some distance into the vitreous as threads or fibres between ciliary processes and lens. Posterior to the ciliary processes is an irregular band without pigment; the rest of the choroid is about normal. The centre of the lens is yellowish and firm, its margin clear and soft. The iris is adherent to the lens below, but seems free elsewhere.

CASE IX.—*Wound in Ciliary Region, followed by Destructive Sympathetic Inflammation, commencing about ten weeks after Injury. Ultimate Recovery of Useful Vision in Wounded Eye.*

William L., æt. 11. Admitted February 26, 1877.

Right eye. Wounded by a sharp piece of sheet tin, in the middle of last December. There is now a horizontal linear cicatrix passing through the outer third of the cornea into the ciliary region. It has not been painful.

Left eye. Dimness of sight and pain commenced four days ago. Cornea is hazy, with ciliary injection below; no synechiæ; vitreous seems clear. Ordered Gutt. Atrop., Heurteloup, quinine, dark shade.

March 12. *Left.* Cornea more steamy; pupil widely dilated; no pain. April 19. *Left.* Well marked keratitis punctata; pupil widely dilated; eye continues irritable. V c + 10″ = Jaeger 6 (letters). *Right* reads Jaeger 20. Pupil covered by thin membrane, and does not dilate with atropine. Fundus barely illuminated; no details ascertained. There is a track of opacity behind iris, at seat of wound. May 21. No pain in either; says he sees better. *Right* eye reads Jaeger 16; *left* eye reads Jaeger 19, barely. The increased defect in the left is due to an increased opacity of Descemet's membrane; iris swollen. *Right* eye. Cornea quite clear; ciliary region still slightly congested. June 11. *Right* V = $\frac{20}{200}$, and reads small words of Jaeger 4. *Left* reads Jaeger 16, and letters in Jaeger 14. Discharged.

Examined on Aug. 13. *Right* V = $\frac{20}{200}$, and small words of Jaeger 1. *Left* can barely distinguish large objects; cannot count fingers.

Examined on Jan. 3, 1878. *Right* eye. No pain. T.n. Opacity in lens ? traumatic. Reads Jaeger 2, slowly, and some words of Jaeger 1. *Left* eye has sometimes stabbing pain. + T. 1½. Cornea hazy. Ciliary region much injected and bulging. V = bare perception of light.

Case X.—*Peripheral Corneal Wound. Sympathetic Inflammation about three months later. Useful vision retained in each, better in the Injured Eye.*

James T., æt. 15. Admitted Nov. 25, 1876.

Right eye. Old penetrating wound of cornea from blow with a hard piece of mortar six months ago. Cicatrix at upper inner corneal periphery, with anterior synechia; no pain. Keratitis punctata. T.n. V = fingers at 4 feet.

Left eye. Sight began to grow dim about three months ago. Keratitis punctata. Over the entire posterior surface of the cornea are small grey punctiform opacities, decreasing in size and number above. T.n. V = fingers at 15 inches. Ordered gutt. atrop., iodide of potassium and mercurial vapour-bath. Dec. 7. Improving slowly; slight salivation. *Left* counts fingers at 18 inches. 9. *Left* counts fingers at 5 feet. 12. *Left* counts fingers at 6 feet. *Right* counts fingers at 9 feet. Discharged Dec. 23.

Examined Feb. 25, 1878. *Right* had iridectomy done upwards elsewhere one month ago; slight bulging at recent scar. T.n. Posterior synechiæ. V = fingers at 7 feet. *Left* T.n., or + T. 1? Pupil excluded and occluded. Counts fingers at 5 feet. There is much organised lymph in both pupils.

Case XI.—*Iridectomy for Glaucoma, followed by Mild Sympathetic Inflammation three months later. Excision. Good Result.*

Samuel W., 50. Admitted August 13, 1877.

Right eye. Iridectomy was done here fourteen weeks ago for glaucoma. At that time there was commencing ulceration at the upper corneal margin. The incision was made downwards, but in the usual manner; the iris tore readily, and part was left in the wound. Since then the ulceration extended over the whole cornea, and now the globe is injected, but not painful.

Left eye. Sight began to grow dim about a fortnight ago. No pain. Well marked keratitis punctata (no note of tension).

Right excised. *Treatment.*—Shade and dark room; no atropine. 18. Pupil dilated and inactive. 29. Pupil rather dilated,

but moderately active. T.n. Small dots of lymph at margin of iris and on anterior lens capsule. V = $\frac{20}{30}$ not improved by glasses; with + 24″ reads Jaeger 1 at 10″. Discharged Aug. 30.

Examined on Feb. 25, 1875. Still small punctate deposits on back of lower part of cornea; pupil fairly active. T.n. V = $\frac{20}{20}$ almost perfectly, and c. + 24″, reads Jaeger 1 at 10″ to 12″. He has occasional attacks of dimness in the morning, lasting for some hours; slight haziness of the margin of the optic papilla. His manner is highly agitated, and he trembles much. Smokes 2½ ounces tobacco weekly.

Case XII.—*Injury and Panophthalmitis of One Eye; Excision six weeks later. Occurrence of Rather Severe Sympathetic Inflammation a few days after Excision. Vision Improved by Iridectomy. Removal of Lens with bad Result.*

Frances L., æt. 59. Admitted December 11, 1876.

Left eye injured about seven years ago by the bursting of a ginger-beer bottle. Removed six weeks after injury. *Right* eye. Sympathetic inflammation commenced some days after the removal of the left. The old notes of this case are, shortly, as follows:—"Sept. 23, 1869. *Left.* Injury by bursting of bottle; cornea divided; panophthalmitis. 24. *Left.* Excised. 28. Discharged." Re-admitted "Oct. 5, 1869. *Right* eye was quite well at time of excision of left. Now sympathetic ophthalmia; iris indistinct; pupil oval horizontally, irregular, undilatable; slight pain; vision much impaired. T.n. Anterior chamber very small. Has eczema of head. Ordered atropine and fot. bellad. 10. Much improved; no pain; pupil more dilated, and iris distinct. 16. Vision improved. Discharged." Re-admitted "Nov. 18, 1870. *Right* eye. Sympathetic iridochoroiditis; pupil occluded; bare perception of light. + T. 1. 23. Iridectomy; iris very friable, only a small piece removed. 28. No pain. T.n. Very fair coloboma. Dec. 3. Eye quiet. Discharged." Re-admitted "May 5, 1873. Iridectomy done so as to increase the size of the old coloboma. Did well for four days, then slight attack of erysipelas, and discharged."

On examination now the right eye counts fingers at 14 inches. + T ? Surface of lens covered by a dense mass of uvea; at one or two points where this is absent the lens looks opaque. A fine needle was used to detach the wall and capsule all round; then a small incision was made with a keratome, and as much as possible of the capsule removed with iris forceps. The lens was then extracted; it was partially opaque with striæ. 14. There has been œdema of the lid, and some pain in the eye. Using belladonna fomentation and daturine drops. 16. Still considerable œdema; eyelids and cheek erythematous; eye looking well. Is now using poppy fomentation, and having quinine and iron internally. 28. — T. ? Occasional shooting pain. 30. Discharged. She was examined on Feb. 25, 1878. Pupil quite blocked; iris drawn up. T.n., or slightly minus. Bare perception of light. Has occasional photopsiæ; lacrimation on exposure.

Case XIII.—*Penetrating Wound of Globe, followed by Sympathetic Inflammation three weeks later. Excision of Injured Eye five days after commencement of the Inflammation. Result satisfactory.*

Louisa P., æt. 4. Admitted December 19, 1877.

Twenty-six days ago she fell on a fork, one prong of which penetrated the left lower eyelid in a direction upwards and inwards, and entered the corresponding eyeball. She had great pain in this eye for the first day; since then she has complained chiefly of pain in the left temple. Five days ago the right eye became painful, and has continued so ever since, with occasional remissions. *Left* eye. Just outside the corneal margin, down and in, is a round cicatrix with an anterior synechia; thin layer of lymph in the pupil and posterior synechiæ; anterior chamber shallow below. *Right* eye. Ciliary injection; slight muddiness of aqueous fluid; iris looks woolly; pupil irregular from posterior synechiæ. *Left* excised on admission. Ordered atropine drops to R.E. six times daily; dark bandage. On Jan. 9, 1878, the right pupil was well dilated. Discharged. Examined March 15, 1884. The right eye is still occasionally painful, and there is much lacrimation. There is also sometimes pain in the left socket. There are two leucomata on the right

cornea, near the centre; these were first observed about four years ago, after having her eye inflamed. Pupil dilated to medium size under atropine, and covered with thin layer of organised lymph. T.n. Spells Jaeger 16 with difficulty.

Pathological Examination.—No anterior chamber below, but elsewhere it is of its usual depth; iris flocculent; pupil excluded; lens cataractous. *Equatorial section :*—Vitreous shrunken to a small yellowish-green globular mass at back of lens, behind which is a yellowish, thin, clear fluid. Retina and choroid *in situ*. Optic disc swollen, blood-vessels very small, margin hazy and indistinct. Choroid not thickened to the naked eye, but it contains some clusters of inflammatory cells distributed at intervals in its middle strata. In the anterior part of the globular vitreous is a yellowish-white nodule of lymph, close in front of which is a layer of dark extravasated blood, and close to this again is the lens. The latter is clear, except at track of wound which leads towards the lymph in vitreous. Iris adherent to wound, and enormously thickened by inflammatory cells in its stroma. Similar cells are found among and behind the scattered pigment granules of its uvea. Numerous inflammatory cells in connective tissue lining the ciliary muscle internally and in the anterior part of the choroid.

Case XIV.—*Penetrating Wound of Globe followed by Sympathetic Inflammation about three months later. Result unfavourable.*

Charles F., 5, admitted June 11, 1878.

The right eye was wounded with a rather blunt-pointed three-pronged corn-rake about the middle of last August. In the middle of November the left eye was noticed to be red and dim-sighted. No particular pain has been complained of. *Right* eye. Large cicatrix at corneal margin up and in. Iris very vascular and drawn towards cicatrix. Cornea nebulous. — T. 2. No perception of light. *Left* eye. Cornea hazy. Iris vascular. + T. 2. Bare perception of light, but much photophobia. Ordered atropine drops frequently. Inunction with mercurial ointment to slight salivation. June 26. *In statu quo.* Discharged. No subsequent account could be obtained.

Case XV.— *Severe Pain in an old Lost Eye followed by Sympathetic Inflammation of a most Intractable Nature. No Benefit from Excision of the Exciting Eye. Operation for Secondary Glaucoma followed by Relief of Tension, but no Improvement of Vision.*

Martha C., 28. Admitted Jan. 14, 1878.

The left eye was inflamed after measles in early childhood, and has been blind ever since. About seventeen months ago it became very painful for the first time, and then also the right eye became dim-sighted, especially in the evenings. There has been no pain in the right, and lacrimation only on getting up and going to bed.

Left eye. Cornea prominent, with large nebula. Ciliary injection and stretching. Pupil small and inactive. Lens hazy. + T. 2. Bare perception of light. Much convergent strabismus. *Right* eye. Pupil eccentric down and in. Acts imperfectly to light. V not tried accurately on admission. 15. *Left* excised. 19. *Right.* Pupil bound down. One or two minute dots on Descemet's membrane. $V = \frac{20}{50}$ Hm $\frac{1}{36}$. Jacg. 1 at 8″ slowly. Ordered atropine drops four times daily. 25. Vision unaltered. Pupil very slightly dilated; iris bound down at pupillary margin with lymph. No pain. T.n. Discharged Jan. 29.

Re-admitted May 28. For the last seven days there has been pain in the right eye and catarrhal discharge. *Right.* Lids slightly swollen. Much conjunctival injection. Pupil excluded. Iris bulged. Anterior chamber shallow. T.n. or slightly —. Bare perception of light. Severe pain in eye and right side of head. Ordered black bandage, atropine drops, two leeches to temple. This severe pain continued, but was always relieved temporarily by leeching. June 6. Ordered Hydr. c. Cret. gr. 1, ter in die. 10. Has severe right hemicrania. Occasional pain in eyeball, shooting to whichever side is dependent. + T. 1 or more. 12. Eserine drops four times daily. 18. Eserine discontinued; it seems to increase the pain. T. still +. 20. Mercurial inunction. 21. Slight salivation; discontinue mercury. 24. Iris much bulged forwards. The pain is not severe now, and she feels

better in herself. July 4. Has complained of pain in both legs, and inability to stand well for the last few days. The cutaneous sensibility of the left leg is diminished. Menstruation regular but scant. Aug. 13. Ciliary staphylomata appearing diametrically opposite one another above and below, the one is up and in and the other down and out. V = hand-reflex barely. Sept. 3. + T. 1 or more. No pain for last month or more. The pupil is occluded by a thin membrane, allowing a faint reflex from fundus. The staphylomata are increasing in size; there is now a third one just midway between the other two in the outer ciliary region. Sept. 10. Incision made through outer part of cornea with linear knife. Iris seized with forceps and dragged from its ciliary attachments all round, and removed *en masse*. A little soft lens matter escaped, from injury either with the knife or forceps-traction. Remainder of lens left in position. Blood in front part of eyeball. 16. Eye quiet. Lens opaque. Staphylomata much lessened in size. Oct. 10. Eye fairly quiet. Bare perception of light. — T. 1. Discharged.

Examined March 12, 1884. The right eye is somewhat shrunken. T.n. No perception of light. Large opacity, involving entire cornea, with the exception of two small areas at upper periphery. This opacity is partly superficial but principally deep. No fundus reflex anywhere.

Pathological Examination.—Globe of normal size. T +. White semi-opaque nebula, not very dense, in centre and lower part of cornea. Anterior chamber fairly deep. Iris somewhat woolly. Pupil not perfectly round. *Equatorial Section:*—Vitreous is fluid in the centre; its peripheral part is firm and in position, but separates readily from the retina. Optic disc deeply cupped in centre; arteries small; veins of fair size. Sclerotic about normal thickness. Lens clear, *in situ*. Iris thinned, with absence of uveal pigment all round the pupil, but especially on outer side below, where it presents a papery appearance. Greyish white patches from loss of pigment on posterior part of ciliary body, and similar areas just behind ora serratu. *Microscopical Examination.*—Ciliary body atrophied, especially as regards its muscular fibres; ciliary folds shrunken; circulus arteriosus somewhat large. Base of iris adherent for a considerable distance, and much thinned; iris generally atrophic, containing some excess

of nuclei. Canal of Schlemm small, occupied by blood corpuscles, and surrounded by a few inflammatory nuclei. Posterior part of pars ciliaris retinæ is cystic. Considerable exudation extending from adherent base of iris for some distance on to adjacent posterior elastic lamina; it is almost structureless, a few nuclei only being visible in it. A central funnel-shaped pit occupies about one-half of the optic disc, extending nearly down to the lamina cribrosa, which latter is pushed back into a marked curve. Sclerotic over intersheath space on outer side of disc is much thinned, as is also the corresponding part of choroid and retina. Nerve-trunk inflamed, with some increase of connective tissue.

Case XVI.—*Panophthalmitis following Cataract Extraction. Sympathetic Inflammation about ten weeks later. Excision of Shrunken Eye. No Improvement.*

Edward J. G., 60, admitted Feb. 9, 1878.

Right eye. Cataract removed here last October. Notes as follows:—"*Right.* Cataract mature. Pupil active. T.n. Good perception of light. *Left.* Cataract immature; pupil active. T.n. He says his health is fairly good, but he looks delicate, and has been subject to bad bilious attacks. Oct. 27. *Right.* Graefe extraction (under chloroform, not sick). Lens soft and came away well. At evening visit there was slight mucopurulent discharge on bandage; he fainted while being dressed. 31. Panophthalmitis; cornea sloughing. Nov. 22. Had much pain in right eye last night. The sight of the left was very dim for some time this morning. Discharged Nov. 28."

About three weeks ago he first felt pain in the left eye, which was then bloodshot. There was also severe pain shooting from the right parietal region to the left temple, and thence round to the left occiput; this has continued more or less ever since. The sight became very dim on the same day as the pain began. There is much tenderness in scalp over the vertex. *Right.* Globe much shrunken, slightly vascular; puckered cicatrix corresponding to operation wound with small round fleshy swelling just above it on the conjunctiva. *Left.* Ciliary injection. Pupil irregular and does not dilate well. T.n. or slightly—. V= bare perception of hand-reflex. *Right.* Excised. Ordered atropine

drops and dark bandage. March 2. The pain has continued to recur at intervals in the left temple and occiput. Mercurial salivation following inunction seemed to lessen this. *Left.* – T. 1. Bare perception of hand. Iris discoloured. Pupil bound down. Cornea cloudy, but no distinct dots visible. Still slight pain in temple and tenderness of scalp. Discharged.

Pathological Examination.—Globe small, especially in antero-posterior diameter. Cornea very small. Just above the operation wound is a small projecting vascular boss; a deep narrow groove leads from this to upper equator. *Equatorial Section.* Globe cuts firmly. Sclerotic swollen, measuring 2 mm. in thickness. Choroid enormously thickened (7 mm.), its inner boundary only indicated by a black ill-defined line. Its substance is greyish white, tough, and somewhat translucent, and extends as such right out to sclerotic. Ciliary body and iris similarly greatly thickened; their uveal pigment much thickened and irregularly scattered. Anterior chamber absent, but iris not adherent to cornea, except at the scar. No trace of lens; retina also indistinguishable, but centre of globe occupied by tough fibrous tissue in which are embedded several calcareous particles.

Microscopical Examination.—Great increase of nuclei in sub-conjunctival tissue at upper corneal margin. The middle of the wound itself is quite 2·5 mm. in front of the canal of Schlemm, which latter is well seen. Extreme peripheral part of cornea much thickened and projecting into anterior chamber. Posterior elastic lamina much undulated. Ciliary body and iris much thickened by exudation on their internal aspect, where it is mixed with much scattered pigment derived from the uveal layer. Substance of ciliary body and iris also infiltrated with numerous inflammatory cells. Choroid enormously thickened on either side of optic disc; it is made up of ill-defined fibrous tissue in which are embedded, especially towards its outer part, large ill-defined clusters of faintly staining nuclei. Interstitial pigment cells of choroid indistinguishable. Retina detached into a cord which loses itself on the tough mass previously described in the centre of the globe. Long ciliary nerves and arteries surrounded by a great number of inflammatory nuclei, which latter have to a comparatively small extent extended into the nerves themselves, half of the long internal ciliary, however, remaining free. Optic nerve-trunk shows marked degene-

rative changes, and contains new inflammatory tissue, both cellular and fibrous.

Case XVII.—*Lost Globe from Injury. Sympathetic Inflammation about a month later. Excision of Injured Eye. Iridectomy in Sympathising Eye. Result fairly good.*

James A., 45, admitted Sept. 24, 1878.

Right eye.—Injured last May by blow with a sharp piece of wood, which deprived it of sight. It was excised elsewhere on June 18. *Left* eye began to look red, with some pain and some photophobia a week before removal of right. After the excision the left eye became a little better, but has been painful at times ever since. The pupil is excluded and occluded; anterior chamber shallow, but no apparent bombiness of iris. Ciliary injection. T.n. Ordered Fot. Bellad. and Gutt. Atrop. Oct. 22. *Left.* Iridectomy inwards. Nov. 8. Eye fairly quiet. Counts fingers with difficulty at 3 feet.

Case XVIII.—*Severe Sympathetic Inflammation occurring some months after Cataract Extraction in the other Eye. Excision of the Sympathising Eye. Retention of Fairly Good Vision in the Exciting Eye.*

Sarah B.,* æt. 67. Admitted Sept. 7, 1878.

Right eye. Cataract extraction here in August 1877. The notes then are, shortly, as follows:—"*Right.* Cataract mature; pupil active; T.n.; good perception of light and good field. *Left.* Cataract nearly mature; pupil active, &c.; can almost count fingers. Aug. 30. *Right.* Graefe extraction; a little soft matter left. Sept. 6. Large prolapse of iris through inner half of incision. Oct. 1. Eye keeps irritable; prolapse snipped off. 23. Pupil closed; iris drawn up; slight thick hypopyon. Discharged." She now states that a few months after her discharge the left eye became painful, and has been so, more or less, ever since; sometimes the pain is very severe. *Right.* Pupil drawn up and filled with opaque membrane and ? lens matter; anterior chamber exceedingly shallow; iris seems in contact with cornea

* This patient is one of four sisters who have been operated on here lately for senile cataract.

in several places. T.n. Eye quiet. Good perception of light. *Left.* Iris much thickened, and in contact with cornea. T. + 2. V = light perception. Ordered Fot. Belladonnæ. 19. The left eye continues liable to severe attacks of pain, and was *excised* to-day. 23. Discharged. Doing well.

Re-admitted Oct. 7, 1878. *Right.* Pupil drawn up and blocked; iris in apposition with cornea down and in. T.n. V = bare perception of large objects. 10. Weiss' scissors used from outer side, and good slit made. Considerable loss of fluid vitreous. 14. There is still a good pupil. 22. *Right.* $c + 3\frac{1}{4}'' V = \frac{20}{100}$. No distinct improvement with cylinders. c + 2″ reads Jaeger 10 at 6″. Discharged Oct. 26.

Pathological Examination.—Globe normal size. T. + 2. No anterior chamber. Iris: pupillary margin irregular and dark, surface dull and closely applied to cornea. Pupil presents an opaque, white, spermaceti appearance.

Equatorial Section. Sclerotic not thickened. Vitreous appears as a small, translucent, semi-gelatinous globe on posterior surface of lens and ciliary processes. Posterior to this, and occupying the space between this and the retina, is a thin fluid. Optic disc ill-defined, and looks large; not cupped. Arteries small, with perivasculitis; veins rather large.

Vertical Section of anterior half. Pupillary margin of iris adherent to anterior lens capsule. Lens *in situ*; its nucleus moderately firm, periphery soft. On internal surface of choroid, especially near the inner equator, are very numerous colloidal particles.

Case XIX.—*Sympathetic Inflammation occurring three weeks after Injury. Result Unfavourable.*

Philip L., æt. 7. Admitted Jan. 31, 1878.

Right eye. Wound with tip-cat at corneal periphery, close to ciliary region, four weeks ago. Has been rather painful lately.

Left eye. One week ago this eye became dim-sighted. It has not been painful. Much pink ciliary injection. Counts fingers with each eye at about 2 feet.

Ordered atropine drops to both eyes, and Hydrarg. c. Cret. gr. 1 ter in die.

Feb. 4. *Left.* Pupil round and well dilated; ciliary region congested; much lacrimation in both.

Feb. 13. *Left.* More injection; eye very watery; anterior chamber deep; iris slightly discoloured; counts fingers at about 9 feet.

Right. Much lacrimation; counts fingers at 1 foot with difficulty.

Feb. 14. *Left.* Pupil round and nearly wide. *Ophthalmoscopic Examination.*—Vitreous cannot be properly examined owing to photophobia and lacrimation; fundus well illuminated: some retinal vessels seen clearly, but optic disc could not be examined. T.n. Ordered Hydr. c. Cret. gr. 2 ter die.

Feb. 15. Much pain in left eye this morning. Much ciliary injection. — T. 1. To have two leeches to left temple.

Feb. 18. To have pills four times daily.

Feb. 21. Continue pills. To rub in 5 grains of mercurial ointment daily.

Feb. 25. Rub in 5 grains twice daily, in addition to the pills.

March 1. No effect yet from the mercurials.

Right. Iris vascular and bulging; pupil excluded and occluded. Bare perception of hand.

Left. Cornea steamy, with a few minute points on posterior surface, and a large deposit at lower part. Pupil excluded?; iris bulging slightly, but fairly dilated. Great photophobia. No pain. Counts fingers at about 18 inches.

March 5. Discharged.

From March 7 till June 28 he was an in-patient at the London Hospital. His right eye was excised there, and the left treated with atropine and belladonna fomentations.

Examined July 30, 1884. The left is now a shrunken stump, with absolutely no perception of light.

Case XX.—*One Eye Lost and Shrunken from Old Inflammation following Injury. Sympathetic Inflammation several years later. Ultimate Improvement from Iridectomy.*

George S., æt. 55. Admitted June 22, 1878.

Left eye excised here eight years ago. The notes taken then are:—"May 12, 1870. Left eye lost ten years ago; result of injury by blow. It was operated on here (nature of operation

unknown). It is now shrunken. The right eye has seemed in a fog for the last week, with muscæ. Pupil acts well, but there are posterior synechiæ under atropine. Fundus seen hazily; no lesion visible. $V = \frac{20}{50}$, and letters of Jaeger 2. May 19. *Left.* Excised; detached choroid, &c."

Now the right eye is in the following condition:—The iris is slightly velvety. Good anterior chamber. Pupil reacts partially and feebly to light; it is occluded, and there are several posterior synechiæ. Lens cataractous. T.n. or full. Counts fingers at $4\frac{1}{2}$ feet. 24. Iridectomy down and in. To wear a black bandage and have mercurial inunction. July 11. Eye doing well; gums touched; stop inunction. 16. Reads Jaeger 18 from 8″ to 24″. Iris now is of almost natural appearance; not velvety. Good fundus reflex, but no accurate details. The lens opacity is chiefly nuclear. Discharged to-day.

Examined May 10, 1884. *Right.* Good coloboma. Iris looks normal. Nuclear haze of lens. Reads Jaeger 14, barely. He says *right* was first affected about three years after operation on *left.*

(*To be continued.*)

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Part I.

Original Contributions.

THE REFRACTIVE CHARACTER OF THE EYES OF MAMMALIA.

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Although from time to time many incidental references to the refractive character of the eyes of mammalia have been made, we believe that hitherto a publication embodying the results of a systematic examination of the eyes of living animals has not appeared.

We therefore examined the eyes of a large number of living mammals, in most cases without the aid of any anæsthetic; the proceeding, however, has been in the highest degree difficult, and the results can only be regarded as approximate in character.

The general result has been fairly satisfactory, especially if it be regarded from an evolutionary standpoint.

Naturally we wished to estimate the refraction of the eyes in the visual axis, but as it is apparently impossible

not only to ascertain whether there is an angle α in animals, but even to determine the direction of the visual axis, we simply estimated the refraction in an axis passing from the middle of the fundus through the centre of the cornea, that is, virtually in the optic axis. In the human eye it has been shown that the refraction at the optic disc differs from that at the yellow spot (7); in some animals (notably guinea-pigs) we also found marked differences between the disc and the centre of the fundus, and we have no hesitation in pronouncing the results obtained in these cases by estimation at the disc to be unreliable.

One of the greatest difficulties we experienced was to keep the eye of an animal fixed in one position even for a minute; but this was best overcome by carefully wrapping the animal in a cloth, to keep it warm, and then fixing the head firmly with the hand. Most of the work was done in a dark room, the only light entering the animal's eye proceeding from the ophthalmoscope mirror, and very often the animal quietly regarded the light for several minutes at a time.

Of the two objective methods at our disposal for estimating the degree of refraction of an eye, retinoscopy and the direct examination, we chose the former and practised it in the following manner. Whilst an assistant held the animal's head firmly, one of us from a distance of 1·5 to 2 meters threw the light by means of a concave mirror of 25 cm. f.d. into the eye, whilst the other held the trial lenses close to the cornea and at right angles to the direction in which the animal appeared to be looking. The estimation had to be frequently repeated before a satisfactory result was obtained. Estimation by the direct method is very difficult and unreliable, since estimation at the disc gives inaccurate results; if, as in the case of rabbits and guinea-pigs, there are neither blood-vessels nor tapetum, the method is impracticable. In those cases where it was possible we have endeavoured to corroborate by the direct method the results obtained by retinoscopy.

In the cases of the smaller animals we estimated the refraction both before and after the application of atropine, which presumably paralyses any accommodation they may possess.

Refraction of the Eyes of Rabbits.

We have examined the eyes of twenty-seven rabbits—in the majority of cases both before and after the use of atropine.

Before proceeding to analyse our results, we wish to state that we are at issue with Wolfskehl (1) on a matter of fact. The pupil of every one of the 54 rabbits' eyes we examined was oval, the long axis of the pupil being vertical. The difference between the diameter of the pupil in the vertical and in the horizontal meridian was never very great, and when dilated by atropine the pupil appeared to be round. Certainly he only refers to the examination of the eyes of two rabbits, and as he does not mention the variety to which they belonged, it is possible that they belonged to a class of rabbits which have round pupils. Yet he makes a general statement on the subject: "Ausserdem vermehrte ich die bereits bekannten Maasse von Kaninchenaugen durch einige eigene Messungen, um Vergleiche mit Augen, welche eine *stets** rund Pupille besitzen, anstellen zu können." He further states that Schelske (3) found "dass die Cornea des Kaninchenauges, das eine immer kreisrunde Pupille besitzt," &c. Whether in this subordinate sentence he is making a statement of his own or not we cannot say, but we have been unable to find any reference to a "kreisrunde Pupille" in Schelske's original article. We should not have referred to this matter were it not of great importance when viewed from a teleological standpoint.

* The italics are ours.

THE EYES OF RABBITS.

Animal.	Results given by retinoscopy before the application of atropine, less 0·5 D.		Results given by retinoscopy after the application of atropine, less 0·5 D.		Remarks.
	Vertical meridian.	Horizontal meridian.	Vertical meridian.	Horizontal meridian.	
(1.) Adult domestic rabbit, albino ..... right eye	− 2 D.	0	− 2 D.	0	
left eye	− 2 D.	+ 0·5 D.	− 2·5 D.	0	
(2.) Adult domestic black and white rabbit .. right eye	..	..	+ 1·5 D.	+ 1·5 D.	
left eye	..	..	+ 2 D.	+ 2 D.	
(3.) Adult domestic grey and white rabbit ... right eye	+ 1 D.	+ 0·5 D.	+ 1 D.	+ 0·5 D.	
left eye	+ 1 D.	+ 0·5 D.	+ 1 D.	+ 0·5 D.	
(4.) Adult domestic rabbit right eye	+ 3 D.	+ 2 D.			
left eye.....	+ 3 D.	+ 2 D.	+ 3 D.	+ 2 D.	
(5.) Adult domestic rabbit right eye	+ 3 D.	+ 2·5 D.	+ 3 D.	+ 2·5 D.	
left eye	+ 3·5 D.	+ 3 D.	+ 3 D.	+ 2·5 D.	
(6.) Adult domestic rabbit right eye	+ 2·25 D.	+ 2·75 D.			This animal died before retinoscopy was practised.
left eye.....	+ 2·5 D.	+ 3 D.			
(7.) Adult domestic brown rabbit ..... right eye	+ 1·5 D.	+ 2·5 D.	+ 2·5 D.	+ 2 D.	
left eye.....	+ 2 D.	+ 1·5 D.	+ 1·5 D.	+ 1·5 D.	

THE EYES OF RABBITS—*continued.*

Animal.	Results given by retinoscopy before the application of atropine, less 0·5 D.		Results given by retinoscopy after the application of atropine, less 0·5 D.		Remarks.
	Vertical meridian.	Horizontal meridian.	Vertical meridian.	Horizontal meridian.	
(8.) Adult domestic rabbit { right eye	+ 1·5 D.	+ 1 D.	+ 1·5 D.	+ 1·5 D.	
left eye	+ 1·5 D.	+ 1·5 D.	+ 1·5 D.	+ 1·5 D.	
(9.) Adult domestic brown and white rabbit ... { right eye	+ 2 D.	+ 3 D.	+ 2 D.	+ 3 D.	
left eye	+ 2 D.	+ 3 D.	+ 2 D.	+ 3 D.	
(10.) Half-grown grey and white rabbit ..... { right eye	+ 1·5 D.	+ 4 D.	+ 1·5 D.	+ 3·5 D.	
left eye	+ 1·5 D.	+ 4 D.	+ 2 D.	+ 4 D.	
(11.) Half-grown brown and white domestic rabbit { right eye	+ 2 D.	+ 3 D.	+ 2 D.	+ 2·5 D.	
left eye	+ 2 D.	+ 3 D.	+ 2 D.	+ 2·5 D.	
(12.) Adult brown and white domestic rabbit ..... { right eye	− 2 D.	− 2·5 D.	− 2 D.	− 2 D.	
left eye	− 1·5 D.	− 2 D.	− 1·5 D.	− 2 D.	
(13.) Adult white domestic rabbit ..... { right eye	+ 2·5 D.	+ 4 D.	+ 2·5 D.	+ 3·5 D.	
left eye	+ 2·5 D.	+ 4 D.	+ 2·5 D.	+ 3·25 D.	
(14.) Adult white domestic rabbit ..... { right eye	+ 2·5 D.	+ 3·5 D.	+ 2·75 D.	+ 3·5 D.	
left eye	+ 2·5 D.	+ 3·5 D.	+ 2·75 D.	+ 3·5 D.	

THE EYES OF RABBITS—*continued.*

Animal.	Results given by retinoscopy before the application of atropine, less 0·5 D.		Results given by retinoscopy after the application of atropine, less 0·5 D.		Remarks.
	Vertical meridian.	Horizontal meridian.	Vertical meridian.	Horizontal meridian.	
(15.) Adult white domestic rabbit ..... { right eye	+ 1·5 D.	+ 2·25 D.	+ 1·25 D.	+ 2 D.	
{ left eye	+ 1·5 D.	+ 3·5 D.	+ 1·5 D.	+ 3 D.	
(16.) Three-quarter grown white domestic rabbit { right eye	− 1·5 D.	+ 1·5 D.	− 1 D.	+ 1 D.	
{ left eye	+ 0·25 D.	+ 1·5 D.	+ 0·25 D.	+ 1·5 D.	
(17.) Three-quarter grown black domestic rabbit { right eye	+ 3 D.	+ 6 D.	+ 2 D.	+ 5 D.	
{ left eye	+ 3·5 D.	+ 5·5 D.	+ 2 D.	+ 5 D.	
(18.) Adult black and white domestic rabbit ..... { right eye	+ 2 D.	+ 2 D.	+ 2 D.	+ 2 D.	
{ left eye	+ 2 D.	+ 2 D.	+ 2 D.	+ 2 D.	
(19.) Half-grown brown and white rabbit ..... { right eye	+ 3·5 D.	+ 3·5 D.	+ 3·5 D.	+ 3·5 D.	
{ left eye	+ 2·5 D.	+ 3 D.	+ 2·5 D.	+ 3 D.	
(20.) Half-grown grey and white domestic rabbit { right eye	+ 1 D.	+ 1 D.	+ 1 D.	+ 1·5 D.	
{ left eye	+ 0·5 D.	+ 0·5 D.	+ 1 D.	+ 1 D.	
(21.) Adult grey domestic rabbit ..... { right eye	− 2 D.	0	0	+ 1 D.	
{ left eye	− 2·5 D.	0	0	+ 1 D.	

THE EYES OF RABBITS—*continued.*

Animal.		Results given by retinoscopy before the application of atropine, less 0·5 D.		Results given by retinoscopy after the application of atropine, less 0·5 D.		Remarks.
		Vertical meridian.	Horizontal meridian.	Vertical meridian.	Horizontal meridian.	
(22.) Adult black and white domestic rabbit	right eye	0	+ 0·5 D.	0	+ 0·5 D.	
	left eye	− 0·5 D.	+ 0·5 D.	− 1 D.	+ 0·5 D.	
(23.) Adult grey domestic rabbit	right eye	+ 1·5 D.	+ 3·5 D.	+ 0·5 D.	+ 2·5 D.	
	left eye	+ 1·5 D.	+ 3·5 D.	+ 1·5 D.	+ 3 D.	
(24.) Adult grey domestic rabbit	right eye	+ 1·5 D.	+ 3·5 D.	+ 2 D.	+ 2 D.	
	left eye	+ 1 D.	+ 3 D.	+ 3 D.	+ 3 D.	
(25.) Adult grey domestic rabbit	right eye	+ 1·5 D.	+ 2·5 D.	+ 2·5 D.	+ 2·5 D.	
	left eye	+ 0·5 D.	+ 2 D.	+ 1·5 D.	+ 1·5 D.	
(26.) Adult grey domestic rabbit	right eye	+ 2 D.	+ 3 D.	+ 2·5 D.	+ 3 D.	
	left eye	+ 2 D.	+ 3 D.	+ 2·5 D.	+ 3 D.	
(27.) Adult sandy-coloured domestic rabbit ...	right eye	+ 1 D.	+ 1 D.	+ 1 D.	+ 2 D.	
	left eye	+ 1·5 D.	+ 1·5 D.	+ 1·5 D.	+ 1·5 D.	

Of the 52 eyes examined without any previous application of atropine, 36 were hypermetropic and astigmatic, 8 were hypermetropic only, 5 were myopic and astigmatic, whilst 3 were characterised by mixed astigmatism. If the hypermetropic and hypermetropic and astigmatic eyes be grouped together, the lesion of refraction was unsymmetrical as regards quality in only three cases.

Of the 51 eyes examined after the application of atropine had caused complete mydriasis, and presumably paralysis of any accommodation the rabbit may possess, 14 were hypermetropic, 31 were hypermetropic and astigmatic, 1 was myopic, 3 were myopic and astigmatic, whilst 2 were characterised by mixed astigmatism. If the hypermetropic and the hypermetropic and astigmatic eyes on the one hand, and the myopic, and myopic and astigmatic eyes on the other, be respectively grouped together, the lesion was unsymmetrical in quality in two animals only.

A comparison of the results obtained before and after the application of atropine shows that—

(1.) In 16 cases the refraction indicated was unaltered.

(2.) In 4 cases the astigmatism remained unaltered, but the total amount of hypermetropia was decreased.

(3.) In 1 case the hypermetropia was increased by 0·5 D.

(4.) In 1 case the astigmatism remained unaltered, and the myopia was increased by 0·5 D.

(5.) In the remaining cases the amount of astigmatism indicated before the application of atropine differed from that indicated after its use.

(*a*.) In 18 cases the difference was from 0·25 D. to 0·75 D.

(*b*.) In 9 cases it amounted to from 1 D. to 2 D.

A survey of this table shows that rabbits have no latent hypermetropia, or that atropine does not paralyse their accommodation. Since atropine paralyses the pupillary muscle of the rabbit to much the same degree that it

paralyses the human pupillary muscle, it seems difficult to believe that it does not affect their accommodation apparatus. The question, however, at once suggests itself, "Do rabbits use their accommodation to an appreciable extent?" If one notes (7) the refraction indicated by retinoscopy in the human eye, during an examination lasting even a few minutes, the degree indicated will be found to vary greatly owing to the activity of the accommodation apparatus. Yet we have watched rabbits' eyes for even an hour, and have never noticed any change. This would lead to the assumption that rabbits do not accommodate to any appreciable extent. We think it probable that their range of accommodation is very limited, and we cannot believe that their accommodation is sufficient to obviate the result of the hypermetropia or of the astigmatism which their eyes usually possess, even when they look at objects situated at an infinite distance from them. In other words, in few cases is a really perfect image formed on their retina.

Hirschberg (5) by means of the ophthalmoscope estimated the refraction at the optic disc of the eyes of rabbits (how many?), and states "dass die Kaninchen nicht bloss (wie die meisten Thiere) übersichtig, sondern auch nicht selten stark astigmatisch sind," and yet earlier he refers to "zum grossen Theil excavirte Sehnervenscheibe." He also makes the following statement: "Man versteht dass die optischen Bilder der Kaninchen- (Pferde-, Hunde-) Augen an Schärfe mit denen der Menschen nicht rivalisiren können, und dass diese Thiere wohl entschieden schlechter sehen als wir selber." Taking our table of the results indicated after the application of atropine as representing most accurately the refractive character of their eyes, it seems that 36 of the 51 eyes were astigmatic. In 13 of these 36 eyes the astigmatism was 0·5 D. or less, in 4 cases it was 0·75 D., whilst in the remaining 19 cases it varied from 1 D. to 3 D.; the total average amount of astigmatism was rather more than 1 D. The position of the two

principal meridians in these astigmatic eyes was always vertical and horizontal, that is, in the direction of, and at right angles to, the long axis of the pupil. No matter in what position the rabbit be placed, it invariably endeavours to keep the long axis of the pupil vertical; if the animal's head be slowly rotated in a vertical plane, it will endeavour to rotate its eyes sufficiently to correct the deviation of its pupils from the vertical. This rotation can be exercised to the extent of about 90°. Its visual knowledge of the outer world is always gained whilst its pupil is maintained in the position referred to.

An examination of these 36 astigmatic eyes shows that the horizontal meridian was that in which the eye was least curved in 29 cases, and that these cases include the cases of myopic and mixed astigmatism, with one exception. In the remaining 7 cases in which the vertical was the least curved meridian, the astigmatism only exceeded 0·5 D. in 1 case. Since the great majority of the eyes were hypermetropic, it is evident that a slit-like pupil directed vertically would enable the animal to obtain the best vision with the least effort, especially if one assumes for the moment that the accommodation is used to correct the hypermetropia. Apart from the fact that, as already stated, this assumption seems to be unwarranted, there are other grave objections to this teleological view of the nature of the slit-like pupil; reference will be made to these later on.

Both Schelske (3) and Wolfskehl (1) seem to have been unable to find any great amount of corneal astigmatism in rabbits' eyes. The latter observer writes: "Es geht nämlich aus ihr (Schelske's Arbeit) hervor: 1. dass die Cornea des Kaninchenauges, das eine immer kreisrunde Pupille besitzt, einen nennenswerthen (regelmässigen) Hornhaut-astigmatismus überhaupt nicht besitzt, womit meine an zwei Kaninchenaugen vorgenommenen Messungen übereinstimmen." He made measurements of the eyes of rabbits before and after death, and says further:

"Es folgt 2. aus Schelke's Messungen, dass Augen, die im Leben keine oder nur geringe Asymmetrie zeigen, auch nach dem Tode keine oder nur eine 0·2 mm. nicht übersteigende Asymmetrie wahrnehmen lassen. Messungen, die ich selbst an einem Kaninchenauge angestellt habe, ergaben als Differenzen des senkrechten und horizontalen Meridians, lebend 0·032 mm., enucleirt 0·184 mm." Nevertheless he himself admits his measurements relate only to the corneal astigmatism, and remarks: "Ob diese Hornhautasymmetrie in den genannten Thieraugen nun wirklich Astigmatismus verursacht oder ob der Hornhautastigmatismus etwa durch Linsenastigmatismus ausgeglichen wird, darüber kann ich etwas Entscheidendes nicht beibringen."

We cannot, therefore, but think that our measurements of the refraction of the whole eye, made on docile, manageable animals with the precautions mentioned, and without the aid of any anæsthetic, represent very nearly the true refractive character of rabbits' eyes.

The Refractive Character of the Eyes of Guinea-pigs.

The results of the examination of twenty-seven guinea-pigs' eyes are noted below. Since these animals possess no tapetum, and their retinæ contain no blood-vessels, accurate estimation by the direct method is impossible. Sections of the optic disc often show a very deep physiological cup, the presence of which complicates retinoscopy and makes any estimation at that point by the direct method valueless.

Hirschberg (5) endeavoured to estimate the refraction of the eyes of guinea-pigs presumably by the direct method (how many he does not state), and apparently did not satisfy himself on the point (probably for the reason we have referred to); he makes the following rather indefinite statement:—"Der Astigmatismus des atropinisirten Auges ist sehr beträchtlich, so dass es kaum gelingt eine

objective Refractionsmessung anzustellen. Doch möchte ich das Meerschweinchen mehr für kurzsichtig halten."

Guinea-pigs are not nearly so manageable as rabbits, and we do not think the quantitative results given below can be regarded as being more than approximate. Their pupils appear to be round, but if eserine be applied they become oval, the long axis of the oval being directed vertically. They endeavour to maintain the pupil in this position if their bodies are rotated by rotating the eyes in a compensating manner, but this rotation is not so extensive as in the case of rabbits.

THE EYES OF GUINEA-PIGS.

Animal.		Result given by retinoscopy before the application of atropine, less 0·5 D.		Result given by retinoscopy after the application of atropine, less 0·5 D.	
		Vertical meridian.	Horizontal meridian.	Vertical meridian.	Horizontal meridian.
(1.) Adult black guinea-pig	right eye	− 6·5 D.	− 5·5 D.	− 6·5 D.	− 6·5 D.
	left eye ..	− 5·5 D.	− 5·5 D.	− 6·5 D.	− 6·5 D.
(2.) Adult yellow guinea-pig	right eye	− 9·5 D.	− 6·5 D.	− 9·5 D.	− 6·5 D.
	left eye ..	− 8·5 D.	− 7·5 D.	− 8·5 D.	− 7·5 D.
(3.) Adult black guinea-pig	right eye	− 4·5 D.	− 7·5 D.		
	left eye ..	− 4·5 D.	− 5·5 D.		
(4.) Adult yellow guinea-pig	right eye	+ 1·5 D.	+ 3·5 D.	+ 3·5 D.	+ 5·5 D.
	left eye ..	+ 2·5 D.	+ 3·5 D.	+ 2·5 D.	+ 4·5 D.
(5.) Adult yellow and white guinea-pig	right eye	+ 0·5 D.	+ 4 D.	0	+ 3 D.
	left eye ..	+ 1 D.	+ 4 D.	+ 2 D.	+ 5 D.
(6.) Adult black and yellow guinea-pig	right eye	+ 2 D.	+ 4·5 D.	+ 2·5 D.	+ 5 D.
	left eye ..	+ 2 D.	+ 5 D.	+ 1·5 D.	+ 4·5 D.
(7.) Adult yellow and white guinea-pig	right eye	+ 0·5 D.	+ 4·5 D.	+ 1 D.	+ 4·5 D.
	left eye ..	+ 0·5 D.	+ 2·5 D.	+ 1 D.	+ 4 D.
(8.) Adult black guinea-pig	right eye	+ 0·5 D.	+ 5·5 D.	+ 0·5 D.	+ 5·5 D.
	left eye ..	+ 0·5 D.	+ 5·5 D.	+ 0·5 D.	+ 5·5 D.

THE EYES OF GUINEA-PIGS—*continued.*

Animal.		Result given by retinoscopy before the application of atropine, less 0·5 D.		Result given by retinoscopy after the application of atropine, less 0·5 D.	
		Vertical meridian.	Horizontal meridian.	Vertical meridian.	Horizontal meridian.
(9.) Adult black and yellow guinea-pig	right eye	+ 4·5 D.	+ 4·5 D.	+ 4·5 D.	+ 4·5 D.
	left eye ..	Nebulæ on cornea.			
(10.) Adult yellow and white guinea-pig	right eye	− 1·5 D.	+ 2·5 D.	0	+ 4·5 D.
	left eye ..	−10·5 D.	− 4·5 D.	− 10·5 D.	− 4·5 D.
(11.) Adult yellow and white guinea-pig	right eye	+ 2·5 D.	+ 6·5 D.	+ 2·5 D.	+ 5·5 D.
	left eye ..	Nebulæ.			
(12.) Adult black and white guinea-pig	right eye	+ 2·5 D.	+ 5·5 D.	+ 2·5 D.	+ 5·5 D.
	left eye ..	+ 0·5 D.	+ 5·5 D.	+ 0·5 D.	+ 5·5 D.
(13.) Adult black and white guinea-pig	right eye	+ 2·5 D.	+ 5·5 D.	+ 3·5 D.	+ 7·5 D.
	left eye ..	− 1·5 D.	+ 3·5 D.	+ 1·5 D.	+ 5·5 D.
(14.) Adult yellow guinea-pig	right eye	+ 6·5 D.	+11·5 D.	+ 6·5 D.	+ 9·5 D.
	left eye ..	+ 2·5 D.	+ 4·5 D	+ 4·5 D.	+ 7 D.

The refraction of the eyes of (1) and (2) represents the myopia in the region of the optic disc. We estimated it purposely in that region, and we have eliminated these cases from subsequent calculation.

Before the application of atropine it appeared that 1 eye was hypermetropic, 16 were hypermetropic and astigmatic, 3 were myopic and astigmatic, whilst 2 were characterised by mixed astigmatism.

After the application of atropine it appeared that 1 was hypermetropic, 18 were hypermetropic and astigmatic, and 1 was myopic and astigmatic. The marked and erratic difference between the two sets of results point to (1) the irregularity of the animals' eyes, and (2) the relative inaccuracy of the method of examination. Still a

survey of the results indicates either that these animals have no latent or manifest hypermetropia, and that the hypermetropia is not corrected by any accommodation they possess. It will be further noted that the departure from the normal type of eye is much greater than in the case of the eyes of rabbits. Whether this is to be accounted for by their greater domestication, and by the want of selection in breeding, we are unable to state.

If the results noted of the examination of the eyes under the influence of atropine be regarded as the most accurate statement of the refraction, it seems that the astigmatism varied from 2 D. to 6 D. (average 3·3 D.). The principal meridians have always been marked "vertical" and "horizontal," and they are approximately so, yet it is impossible to determine the normal position of the animal's head, and the direction of the principal meridians very often seemed respectively to coincide with, and to be at right angles to, the direction of the palpebral fissure. In every astigmatic eye the least curved meridian was the horizontal one. Since guinea-pigs possess an almost perfectly round pupil, it is evident that the astigmatism which their eyes usually exhibit must materially impair their vision. If then the slit-like pupil of the rabbit which has an astigmatism averaging a little more than 1 D. was developed to obviate the results of the astigmatism, how much more should the guinea-pig with an average astigmatism of 3·4 D. of a similar qualitative character require a slit-like pupil, and what becomes of the consideration of this pupil in the rabbit from a teleological standpoint? Yet it is evident that in the matter of optical construction the guinea-pig is inferior to the "so nahe verwandten" rabbit.

The Refractive Character of the Eyes of Mice.

The task of estimating the refractive character of the eyes of ordinary wild mice was certainly the most difficult we undertook. It was very difficult to tell in what

direction the animal was looking, and it was quite impossible to keep the animal still.

In the following table we have placed on record the quantitative result obtained; but we should recommend that it be taken to indicate that the ten mice-eyes we qualitatively examined were hypermetropic, and that the hypermetropia was considerable in amount.

THE EYES OF MICE.

Animal.	Result given by retinoscopy without any application of atropine and less 0·5 D.		Remarks.
	Vertical meridian.	Horizontal meridian.	
(1.) Adult grey mouse .. right eye ..	+ 7·5 D.	+ 7·5 D.	
(1.) Adult grey mouse .. left eye ..	+ 3·5 D.	+ 3·5 D.	
(2.) Adult black mouse .. right eye ..	+ 6·5 D.	+ 6·5 D.	The hypermetropia seemed to be a little greater in the horizontal than in the vertical meridian.
(2.) Adult black mouse .. left eye ..	+ 7·5 D.	+ 7·5 D.	
(3.) Adult grey mouse .. right eye ..	+ 5·5 D.	+ 5·5 D.	Ditto.
(3.) Adult grey mouse .. left eye ..	+ 5·5 D.	+ 5·5 D.	
(4.) Adult grey and white mouse .. right eye ..	Hyperm	etropic	
(4.) Adult grey and white mouse .. left eye ..	Hyperm	etropic	
(5.) Adult grey mouse .. right eye ..	+ 4·5 D.	+ 4·5 D.	
(5.) Adult grey mouse .. left eye ..	+ 4·5 D.	+ 4·5 D.	

This table simply shows that ten mouse's eyes were distinctly hypermetropic.

The Refractive Character of the Eyes of Rats.

The examination of the eyes of the five half-wild animals, the result of which is appended, was a little less difficult than that of the eyes of the mice.

Of the 10 eyes examined under the influence of atropine 5 were hypermetropic, 3 were hypermetropic and astigmatic, 1 was slightly myopic, whilst the remaining

THE EYES OF COWS.

Animal.	Results given by retinoscopy before the application of atropine, less 0·5 D.		Remarks.
	Vertical meridian.	Horizontal meridian.	
(1.) Adult milch cow..... { right eye	+ 2·5 D.	+ 3·5 D.	
(1.) Adult milch cow..... { left eye..	+ 2·5 D.	+ 4·5 D.	
(2.) Adult milch cow..... { right eye	Hypermetropic.		
(2.) Adult milch cow..... { left eye..			
(3.) Adult milch cow..... { right eye	0	+ 0·5 D.	
(3.) Adult milch cow..... { left eye..	+ 0·5 D.	+ 0·5 D.	
(4.) Adult milch cow..... { right eye	− 0·5 D.	− 0·5 D.	
(4.) Adult milch cow..... { left eye..	+ 0·5 D.	+ 0·5 D.	
(5.) Adult milch cow..... { right eye	0	+ 0·5 D.	
(5.) Adult milch cow..... { left eye..	+ 0·5 D.	+ 0·5 D.	

The principal meridians were in all cases at right angles to and in the same direction as the long axis of the pupil.

The Refractive Character of the Eyes of Horses.

Of the 6 horses' eyes we examined, 1 was emmetropic, 3 were hypermetropic and astigmatic, and 2 were characterised by very slight mixed astigmatism, that is practically emmetropic. The astigmatism only once equalled 1 D., and the horizontal was always the least curved meridian. Unless these animals corrected a greater lesion of refraction by accommodation—a highly improbable event—it would seem that their eyes were nearly emmetropic.

Hirschberg (5), examining horses' eyes by the direct method, seems to have found much astigmatism, for he writes:—"Im aufrechten Bilde erkennt man die deutliche Chromasie und den starken Astigmatismus des Pferdeauges;" and, further, "Aber auch an centralen Theilen des

Augengrundes, namentlich an den Punkten des Tapetums, ist der Astigmatismus des Pferdeauges deutlich zu erkennen."

Berlin (2) makes the following definite and important statement with reference to the eyes of horses:—"Die beiden bis jetz auf ihre Cardinalpunkte untersuchten Pferdeaugen von Matthiessen und dem Verfasser zeigen beide eine Hypermetropie. Im ersteren Falle ist dieselbe freilich eine sehr geringe, von 0·332 D., welche man etwa einer Emmetropie gleichstellen kann; im zweiten ist sie eine höhere, von ca. 1 Dioptrie," and, further, "Es werden ausserdem ophthalmoskopisch auch niedrigere Grade von Hypermetropie, wie in Matthiessen'schen Falle, Emmetropie, und ausnahmsweise sogar Myopie constatirt. Die stärkste vom Verfasser gefundene Myopie betrug 3 D." After referring to the irregular astigmatism of the lens, he refers to the regular astigmatism of the horse's cornea: —"Diese letztere scheint durchgängig eine ganz bestimmte Form zu haben, in der Art, dass der am wenigsten gekrümmte Hornhautmeridian mit der Längsrichtung der querovalen Pupille zusammenfällt, während der am stärksten gekrümmte Hornhautmeridian zu der Längsrichtung der Pupille annähernd senkrecht steht."

Berlin (4) published an account of the results of his examination of the eyes of domestic animals, but we have unfortunately only been able to find a reference to it. In this reference (Nagel's Jahresbericht) it is stated that he "hat verschiedene Hausthiere ophthalmoskopisch auf ihre Refraction untersucht, und sie durchschnittlich hypermetropisch gefunden." The highest grade of hypermetropia he found was 2·5 D., four times he found myopia in horses' eyes, the greatest amount being 8·5 D.

The normal direction of the pupil, the slit directed horizontally, is maintained with but slight deviation in both extreme elevation and depression of the head.

THE EYES OF HORSES.

Animal.	Result given by retinoscopy before the application of atropine, less 0·5 D.		Remarks.
	Vertical meridian.	Horizontal meridian.	
(1.) Adult horse { right eye...	Myopic	Slightly hypermetropic	
(1.) Adult horse { left eye....	„	„	
(2.) Adult horse { right eye...	+ 0·5 D.	+ 1·5 D.	
(2.) Adult horse { left eye	0	0	
(3.) Adult horse { right eye...	0 D.	+ 0·5 D.	
(3.) Adult horse { left eye	0 D.	+ 0·5 D.	

The principal meridians were respectively at right angles to and in the direction of the long axis of the pupil.

The Refractive Character of the Eyes of Cats.

Of the 14 eyes examined before atropine was applied, 6 were hypermetropic, 4 were hypermetropic and astigmatic, 2 were slightly myopic, and 2 were myopic and astigmatic. The astigmatism exceeded 0·5 D. in 2 eyes only. Of the 12 eyes examined after the application of atropine, 2 were emmetropic, 6 were hypermetropic, 2 were hypermetropic and astigmatic, and 2 were myopic and astigmatic. In the 4 astigmatic eyes the horizontal was the meridian of greatest curvature, but the astigmatism never exceeded 0·75 D.

It will be seen that the cat's eye approaches very closely the emmetropic standard. What amount of accommodation they possess we do not know, but a cat whose pupils are completely paralysed with atropine can effect movements with perfect precision. We applied freely and frequently a strong atropine ointment to the eyes of a cat, and when the pupils were fully dilated, we

allowed the animal to pursue a wild mouse. The cat moved with accuracy and celerity, and made a speedy capture.

Wolfskehl (1) measured the corneal astigmatism of cats, after they had been killed with chloroform, both whilst the eye remained in the corpse, and after it was enucleated. In one of the three eyes he thus examined, the two sets of results obtained seem to us to have differed materially. He found that the two principal meridians respectively corresponded to, and were at right angles to, the direction of the long axis of the pupil, that the astigmatism varied from 1·5 D. to 12·8 D., and that the least curved meridian was always vertical in direction. An astigmatism of 12 D. is enormous, and the fact that his measurements were exclusively corneal compels us to believe that there must have been some other correcting astigmatism in the animal's eye.

Hirschberg (5) writes:—"Das atropinisirte Auge einer getigerten Katze fand ich wenig hypermetropisch;" and, later, "An diesem Punkte" (spots in the retina below the tapetum) "erkennt man leicht den Astigmatismus des atropinisirten Katzenauges," but he gives no further particulars.

Cats apparently (like rabbits) endeavour to keep the long axis of the pupil nearly vertical under all circumstances; owing to the situation of their eyes in the front of the head, the rotation of the eyes necessary to effect this result is not so often called for as in the case of the rabbit, and the movements of rotation, which can be observed when the cat's head is rotated to one side or the other, are not so extensive.

Animal.	Results given by retinoscopy before the application of atropine, less 0·5 D.		Result given by retinoscopy after the application of atropine, less 0·5 D.		Remarks.
	Vertical meridian.	Horizontal meridian.	Vertical meridian.	Horizontal meridian.	
(1.) Adult domestic cat ..... right eye....	Hypermetropic		0	0	A small dose of chloroform administered to keep the animal quiet.
left eye.....	,,		0	0	
(2.) Adult domestic cat ..... right eye...	− 2 D.	− 2·5 D.	− 1·25 D.	− 2 D.	
left eye...	− 1·5 D.	− 2 D.	− 1·25 D.	− 2 D.	
(3.) Kitten æt. 3 months .... right eye....	+ 0·5 D.	+ 2 D.	+ 2·5 D. approximately		
left eye	+ 0·5 D.	+ 2 D.	+ 2·5 D.	,,	
(4.) Kitten æt. 3 months..... right eye..	+ 0·5 D.	+ 1 D.	+ 1·5 D.	,,	
left eye.....	+ 0·5 D.	+ 1 D.	+ 1·5 D.	,,	
(5.) Kitten æt. 2 months..... right eye....	+ 0·5 D.	+ 0·5 D.	+ 1 D.	+ 0·5 D.	
left eye.....	+ 1 D.	+ 1 D.	+ 1·5 D.	+ 1 D.	
(6.) Adult tabby cat ..... right eye....	Slightly myopic	Slightly myopic	+ 0·5 D.	+ 0·5 D.	
left eye.....	Myopic	Myopic	+ 0·5 D.	+ 0·5 D.	
(7.) Adult tabby cat ..... right eye....	+ 1 D.	+ 1 D.			
left eye.....	+ 1 D.	+ 1 D.			

The principal meridians in the astigmatic eyes were in the direction of and at right angles to the direction of the long axis of the pupil.

The Refractive Character of the Eyes of Dogs.

It will be seen that the eyes of the dogs we examined were practically emmetropic.

Hirschberg (5), in referring to the results of his examination of the eyes of dogs by the direct method, writes: "der Astigmatismus ist nicht bloss an Sehnerven, sondern an dem ganzen Gefässbaum der Retina zu erkennen," but again refrains from giving particulars.

THE EYES OF DOGS.

Animal.		Results given by retinoscopy before the application of atropine, less 0·5 D.		Result given by retinoscopy after the application of atropine, less 0·5 D.	
		Vertical meridian.	Horizontal meridian.	Vertical meridian.	Horizontal meridian.
(1.) Poodle aged 3 years...	right eye..	+ 0·5 D.	+ 0·5 D.	+ 0·5 D.	0
	left eye...	+ 0·5 D.	+ 0·5 D.	+ 0·5 D.	0
(2.) Russian grey-hound....	right eye..	Slightly myopic.			
	left eye...	„			
(3.) Russian grey-hound....	right eye..	Slightly hypermetropic.			
	left eye...	„			

As we felt that an objection might be raised to conclusions based only on the results already given, on the ground that the animals were domesticated, we visited Mr. Jamrach's establishment, and made a qualitative examination of the eyes of a number of recently caught wild animals.

Deer.—Siki Deer (Persia), emmetropic both eyes; Cervus Porcinus (2), each hypermetropic both eyes; Black Bock (East Indies) (2), each hypermetropic both eyes.

Jackal.—Hypermetropic in both eyes.

Peccary.—Hypermetropic in both eyes.

Jeanette Cat (South America).—Hypermetropic in both eyes.

Paradoxus Cat (East Indies) (2).—Each hypermetropic in both eyes.

Australian Native Cat.—Hypermetropic in both eyes.

Mongoose.—Hypermetropic in both eyes.

Hyæna (2).—Hypermetropic in all three eyes (one animal had one eye destroyed).

Opossum.—Hypermetropic in both eyes.

Porcupine.—Hypermetropic in both eyes.

Monkeys (11 animals).—Two were myopic in both eyes, and nine were hypermetropic in both eyes.

Conclusions.

An examination of the results obtained by us shows that of the 185 eyes examined—

(1). 24 were emmetropic.

(2). 145 were hypermetropic, or hypermetropic and astigmatic.

(3). 13 were myopic, or myopic and astigmatic.

(4.) 3 were characterised by mixed astigmatism.

All eyes with a hypermetropia, myopia, or simple astigmatism, not exceeding 0·5 D, we have considered to be emmetropic.

It will be seen that about 7 per cent. of the eyes were myopic. Now it has been shown that myopia is essentially a disease engendered by sedentary habits, and therefore by civilisation, but the comparatively large percentage of myopic eyes we have discovered in animals seems to indicate the existence of another productive factor; for we cannot suppose that exercise of the accommodation apparatus influenced the production of this myopia.

Hirschberg (5) writes: "Ich will beiläufig bemerken dass vom teleologischen Standpunkt aus, beim Gegebensein der positiven Accommodation durch willkürlich

angeregte Verdickung der Krystallinse, das axenkurze, also hypermetropische Auge am zweckmässigen erscheint." The truth of this statement no one can doubt if they regard the matter in the abstract, but we simply ask, "What particle of evidence is there that the domestic mammals use their accommodation to any appreciable extent?" It is absurd to suppose that they possess an apparatus capable of overcoming eight or even four diopters of hypermetropia, and so far we have failed to satisfy ourselves that they can overcome the lower grades. We are, however, at present engaged in minutely investigating the matter.

Whilst realising fully the danger of analysing too thoroughly figures which must be approximate in their signification, yet a general survey of those figures shows that as an optical instrument the eye of the horse, cow, cat, and rabbit, is superior to that of the rat, mouse, and guinea-pig.

Is this to be regarded as the result of the selective breeding of the former animals or not? It is at least reasonable to suppose that animals possessing very atypical eyes would often possess other qualities which would render them unfit for breeding purposes; and further that the careful feeding and other attention the domestic animals receive would react favourably on the development of so important an organ.

It will be noticed that we quantitatively examined 76 astigmatic eyes, and that in only 13 of these cases was the horizontal the meridian of greatest curvature. In only 3 of these 13 cases did the astigmatism exceed 0·5 D.; and on these 3 occasions it equalled 1 D. 0·75 D. and 0·75 D. respectively. Although in many of the cases of the opposite group the astigmatism did not exceed 0·5 D., yet that group includes all the cases of severe astigmatism, whether in myopic or hypermetropic eyes. In other words, as the result of our investigation of astigmatic eyes in animals, both hypermetropic and

myopic, we find that in the great majority of cases, and in all severe cases, the horizontal is the least curved meridian, and we estimated the astigmatism of the whole eye, and not that of the cornea only. In the human eye this is also the most common form of astigmatism, but since we found a similar condition in the eyes of animals with round pupils, with vertically directed slit-like pupils, and with horizontally directed slit-like pupils, it seems to be necessary to seek for some widespread cause to explain its existence.

The usual form of an astigmatic eye—a vertically-flattened sphere—is the shape that a soft ill-supported sphere would assume by reason of its own weight. When such a sphere is acted upon by four muscles vertically and by only two horizontally, leaving aside any influence the lids may exert, it is readily conceivable that a weakly-formed sclerotic and cornea should assume the astigmatic shape. Once formed, this shape would have a tendency to be inherited, especially in domestic animals, amongst whom the law of the survival of the fittest does not obtain, at least as regards the eyes. In albino rabbits, which do not admit of much crossing, this defect was always marked, the astigmatism in our cases averaging 1·275 D.

On only one point, however, is the evidence decided and convincing; the principal meridians of the astigmatic eye are always in the direction of and at right angles to the direction of the long axis of the pupil, to this extent only does this evidence justify the consideration of the matter from a teleological standpoint. Were the slit-like pupil developed to obviate the evil results of the astigmatism, we should expect to find that the meridian of least curvature in myopic, and of greatest curvature in hypermetropic eyes, corresponded in direction with the long axis of the pupil. One would also certainly expect that animals with round pupils should not possess very astigmatic eyes. Yet every one of these requirements is unsatisfied, and we find throughout that

the optical construction of these eyes evinces the existence of some general developmental agency which pays little regard to the *existing* shape of the pupil.

We feel that we are quite unable in the present state of our knowledge to conjecture the mode of origin, or even the possible purpose of this slit-like pupil, but we think that the evidence adduced indicates the probability of that explanation being obtained from a developmental and not from a teleological standpoint.

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THE ACTION OF MYOTICS ON THE ACCOMMODATION.

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The Action of Eserine and Pilocarpine on the Accommodation.

In the English edition of Donders' (1) classical work there occurs at p. 613 a reference to the increased range of accommodation produced by the application of a solution of Calabar bean to the eye. In this paper we have endeavoured to throw some light on the nature of this and of other changes in the accommodative apparatus which follow the application of eserine and pilocarpine to the eye.

I.—*The Action of Eserine.*

Method of Investigation.—In our investigations we have used a pink aqueous solution of eserine of 0·5 or 1 per cent. in strength. In the following tables where the application is marked "moderate" we dropped three or four drops of the solution into the lower conjunctival sac, whilst the lid was held away from the globe for half a minute or longer, so that the tears should not wash the drug away. In the cases where the term "profuse" is used this application was repeated at the end of two minutes.

* To Mr. E. F. Herroun, of King's College, we are greatly indebted for several of the calculations embodied in this paper, and we desire to record our thanks to him for the assistance he has kindly given us from time to time.

Duquesnel (10) states that the colouring matter separated from a red solution of eserine does not act as a myotic and that old solutions of eserine should not be used; but that a neutral sulphate of eserine, which dissolves readily, should be kept in powder and dissolved only when about to be used. Again de Wecker (29) refers to this red colour and says that it develops twenty-four hours after the solution is made. Adolph Weber (17), however, seemed to think that the change of colour was not of much importance, for he refers to a change of colour, which both Merck's (Darmstadt) and Vée's (Paris) eserine undergo if kept, and he also says that the red colour in Vée's preparation is darker than in Merck's. Our pink solution had apparently always acted with great vigour, but in order to test the point, we applied to the same eye at different times, but as far as possible in the same manner, a freshly prepared colourless solution of eserine and the pink coloured one, and then compared the results; there appeared to be very little difference between them, if anything the coloured solution appeared to act less strongly than the colourless. We have therefore concluded that this inert colouring matter was not formed in sufficient quantity to interfere with the activity of our coloured solution.

Before applying the drug we ascertained the near point by the wire optometer. (Donders (1), p. 34.) In the case of myopes we also measured the far point with this instrument, but in the case of emmetropes and hypermetropes we ascertained the position of the far point by means of Snellen's test types at 6 M., and of spherical lenses. The optometer was held against a light background illuminated as far as possible to the same extent throughout the entire experiment. The diameter of the pupil was ascertained by means of an ordinary pupilometer, whilst the patient looked in the distance. After completing these measurements the eserine solution was applied either "moderately" or "profusely," and the far

and near points and the diameter of the pupil were ascertained at regular intervals for from 80 minutes to several hours. When the far point in the case of hypermetropes and emmetropes was less than 2 M. distant we usually estimated its position with the optometer so long as it remained within that distance.

In the case of old people the estimation of the far point by the optometer is usually unsatisfactory, probably on account of their diminished acuity of vision. In most of the cases the eye was examined daily for several days after the application of the drug. We have always taken the measurements for the near and

Case I.—C. P., æt. 19. *Right Eye.* V. $= \frac{6}{6}$. Hm. 1 D.

Time.	Pupil.	P.P.		P.R.	
		Vertical.	Horizontal	Vertical.	Horizontal.
Before application	3·5 mm.	9 cm.	9 cm.	−100 cm.	−100 cm.
After application—					
3 minutes	3·5	8·5	8·5	−100	−100
7 „	3	6·75	6·75	23	23
12 „	2·5	5·5	7	27	60
15 „	2	5	4·5	25	22·5
20 „	1·5	4	4	23	23
26 „	1·75	5	4·5	28	33
30 „	1·5	4·5	4·5	37	44·5
36 „	2	5	5·5	76	85
42 „	2	5	5	150	
54 „	2	5	5		
57 „	2	5	5		
72 „	2	5	5		
102 „	2	5·5	5·5		
132 „	2	6	6		
157 „	..	5·5	5·5		
252 „	..	6	7		
312 „	..	7	7		
372 „	..	7	7		
432 „	..	7	7		
552 „	..	7·5	7		
24 hours	*Still contracted*	9 cm.	9 cm.		
48 hours	*Complete recovery*				

far points from the outer canthus, as it is impossible to follow the plan of measuring from a point situated at 7 mm. behind the cornea. Since absolute precision is not to be attained where the subjective element is brought into play, we have endeavoured to eliminate any errors by making numerous observations and by paying attention to the relative rather than to the absolute factors.

Case I. In this eye eserine caused—

(1.) An approximation of the far point, which reached its maximum at the 7th minute, and which disappeared in from 40 to 50 minutes. The maximum approximation was represented by 5·35 D.

(2.) An approximation of the near point, which began at the 3rd minute, reached its maximum in 20 minutes, and remained to a material extent for more than 9 hours. The maximum approximation was represented by 13·89 D.

(3.) A contraction of the pupil which began at the 7th minute, reached its maximum at the 20th minute, and remained for more than 24 hours.

(4.) An increase in the range of accommodation, preceded during the first 7 minutes by a decrease of 1·64 D. The maximum increase occurred at the 54th minute, but the range remained materially increased during the following 8 hours. This increase at its maximum amounted to 8·89 D.; that is, the range was changed from its normal 12·11 D. to 21 D.

It will be noticed that measurements of the far and near points in the vertical and horizontal meridians gave different results during the first 36 minutes of the observation. As it is evident that measurements cannot be made in the two meridians at the same time, and as eserine causes violent clonic spasms of the accommodative apparatus, it is improbable that these differences really represent any astigmatism. (*See* Chart.)

CASE II.—C. P., æt. 19. *Left Eye.* V. $= \frac{6}{6}$. Hm. 1 D. Moderate Application.

Time.	Pupil.	P.P.		P.R.	
		Vertical.	Horizontal.	Vertical.	Horizontal.
Before application	3·5 mm.	9 cm.	9 cm.	−100 cm.	−100 cm.
After application—					
3 minutes	3·5	7	7		
7 „	3	6·5	6·5	25	25
12 „	2·5	4·5	4	18	16
15 „	2	4·5	5	19	15·5
20 „	1·5	4·5	4·5	18	17
26 „	1·75	5	4·5	24	17
30 „	1·5	4·5	4·5	37	35
36 „	1·5	5	5	81	87
42 „	2	4·75	4·75		
54 „	2	4·75	4·75		
57 „	2	5	5		
72 „	2	5	5		
102 „	2	5·5	5·5		
132 „	2	5·5	5·5		
157 „	2	5	5		
252 „	2	6	7		
312 „	..	7	6		
372 „	..	7	7		
432 „	..	7	7·5		
552 „	..	7·5	7·5		
24 hours	..	9	9		
48 hours	Recovery of pupil.				

In this eye eserine caused--

(1.) An approximation of the far point, which began at the 7th minute, reached its maximum at the 12th minute, and disappeared in 42 minutes. The maximum approximation was represented by 6·9 D.

(2.) An approximation of the near point, which began at the 3rd minute, reached its maximum at the 12th minute, and remained to a material extent for more than 9 hours. The maximum approximation was represented by 12·45 D.

(3.) A contraction of the pupil which began at the 7th minute, reached its maximum at the 20th minute, and remained for more than 24 hours.

(4.) An increase in the range of accommodation, preceded by a decrease of 0·73 D. during the first 7 minutes. The maximum increase occurred at the 42nd minute, and the range remained materially increased during the following 8 hours. This increase at its maximum amounted to 9·94 D.; that is, the range was changed from 12·11 D. (normal) to 22·05 D.

Case III.—J. W. B., æt. 23. *Left Eye.* V. $= \frac{6}{6}$. Hm. 0·5.

Moderate Application. Observations in Vertical Meridian only.

Time.	Pupil.	P.P.	P.R.
Before application ...	3 mm.	11 cm.	−200
After application—			
5 minutes	3	9·5	−200
10 „	3	8·5	100
15 „	2·5	8	15
20 „	2	7·5	16
25 „	2	7·5	52
30 „	2	7·5	61
35 „	2	7·5	150
40 „	2	8	−200
45 „	2	8	−200
55 „	2	7·5	−200
75 „	2	8	−200

The near point returned to its normal position within 8 hours, but the pupil remained contracted for more than 24 hours. It had recovered completely within 48 hours.

In this case eserine caused—

(1.) An approximation of the far point, which began at the 10th minute, reached its maximum in 15 minutes, and disappeared in 40 minutes. The maximum approximation was equivalent to 7·17 D.

(2.) An approximation of the near point, which began at the 5th minute and reached its maximum in 20 minutes. The near point remained greatly approximated for 75 minutes, and returned to its normal position in 8 hours. The maximum approximation was equivalent to 4·24 D.

(3.) A contraction of the pupil which began at the 15th minute, reached its maximum at the 20th minute, and remained for 24 hours.

(4.) An increase in the range of accommodation, interrupted between the 10th and 25th minutes by a decrease, which at its maximum was equivalent to 3·76 D.; that is, to more than one-third of the normal range (9·59 D.). The maximum increase occurred at the 55th minute, and was equivalent to 4·24 D., that is, to less than half the normal range, so that the total range at this time was 13·83 D. The increase disappeared within 8 hours.

Case IV.—A. S., æt. 17. *Right Eye.* Observations in Vertical Meridian only. Moderate Application.

Time.	Pupil.	P.P.	P.R.
Before application ...	8 mm.	9·5 cm.	22 cm.
After application—			
5 minutes	7	9	20
10 „	5·5	9·5	15·5
15 „	4	7	15
20 „	2·5	7	13
25 „	2	5	13
30 „	2	5·5	16
35 „	2	5·5	18
40 „	2	5·5	22
45 „	2	5·5	22

In this case the application of eserine caused—

(1.) An approximation of the far point, which began at the 5th minute, reached its maximum at the 20th minute, and disappeared at the 40th minute. The maximum approximation was equivalent to 3·15 D.

(2.) An approximation of the near point, which began at the 5th minute, reached its maximum at the 25th minute, and at that time was equivalent to 9·47 D. This approximation remained to nearly the same extent at the 45th minute, when the far point had receded to its normal position.

(3.) A contraction of the pupil, which began at the 5th minute, reached its maximum at the 25th minute, and remained in this condition at the 45th minute, when the observations were discontinued.

(4.) An increase in the range of accommodation, preceded in the first 10 minutes by a decrease, which at its maximum was 1·91 D.; that is, one-third of the normal range (5·98 D.). The maximum increase occurred at the 40th minute, and was equivalent to 7·56 D.; that is, to more than the normal range; so that at this time the total range was 13·54 D. (*See* Chart.)

Case V.—B. T., æt. 17. V. $= \frac{6}{6} - 1$ D. Observations in Vertical Meridian only. Profuse Application.

Time.	Pupil.	P.P.	P.R.
Before application ...	5 mm.	10 cm.	75 cm.
After application—			
5 minutes	5	9·5	75
10 „	3	6	16
15 „	2	6·5	10
20 „	2	6	12
25 „	2	6·5	12·5
30 „	2	7	12·5
35 „	2	6·5	12·5
40 „	2	6·5	12·5
45 „	2	5·5	14
50 „	2	6	14
55 „	2	5·5	14
60 „	2	5	14
65 „	2	6	41
70 „	2	6	50
75 „	2	6	70
80 „	2	6	100
85 „	2	6	100

In this case the application of eserine caused—

(1.) An approximation of the far point, which began at the 10th minute, reached its maximum at the 15th minute, and disappeared at the 80th. The maximum approximation was equivalent to 8·67 D.

(2.) An approximation of the near point, which began

at the 5th minute, reached its maximum at the 60th minute, and at that time was equivalent to 10 D. This approximation remained to a considerable extent at the 85th minute, when the far point had receded beyond the point it occupied previous to the instillation.

(3.) A contraction of the pupil, which began at the 10th minute, reached its maximum at the 15th minute, and remained in this condition at the 85th minute, when the observation was discontinued.

(4.) An increase in the range of accommodation, interrupted between the 10th and 45th minutes by a considerable and irregular decrease, which at its maximum at the 15th minute was 3·28 D.; that is, less than half the normal range (8·67 D.). The maximum increase occurred at the 80th minute, and was 7 D.; that is, nearly equal to the normal range, which at this time was increased to 15·67 D.

Case VI.—W. L., æt. 32. $V. = \frac{6}{6}\ \bar{c}\ \frac{-4\text{ D. sph.}}{-1\text{ D. cyl.}}$. Moderate Application. Measurements in both Meridians.

Time.	Pupil.	P.P.		P.R.	
		Vertical.	Horizontal.	Vertical.	Horizontal.
Before application	3·5 mm.	9·5 cm.	9·5 cm.	20 cm.	18 cm.
After application—					
5 minutes	3·5	7	7	16	16
10 ,, ...	3·5	7	7	15	15
15 ,, ...	2·5	7	7	12	12
20 ,, ...	2	6·5	6·5	12	12
25 ,, ...	1·5	6·5	6·5	10	12
30 ,, ...	2	7	7	16	13
35 ,, ...	1·5	7	7	16	16
45 ,, ...	1·5	7	7	20	18

In this case the application of eserine caused—

(1.) An approximation of the far point, which began at the 5th minute, reached its maximum at the 25th minute,

and had disappeared at the 45th. The maximum approximation was equivalent to 3·89 D.

(2.) An approximation of the near point, which began at the 5th minute, reached its maximum at the 20th minute, and at that time was equivalent to 4·86 D. This approximation remained to nearly the same extent at the 45th minute, when the observations were discontinued and the far point had receded to its original position.

(3.) A contraction of the pupil, which began at the 15th minute, reached its maximum at the 25th minute, and remained in this condition at the 45th minute.

(4.) An increase in the range of accommodation, which was at its maximum at the 45th minute, that is, when the far point had completely receded, and which at this time was equivalent to 3·76 D., or more than half the normal range (5·25 D.), so that the total range was then 9·01 D.

It will be observed that measurements of the near point in both meridians gave in this case the same results throughout, whereas in the case of the far point slight differences are noticeable. For reasons previously referred to (p. 133) we feel inclined to regard these observations as worthless.

Summary.

A 0·5 or 1 per cent. solution of sulphate of eserine applied moderately or profusely to these healthy emmetropic and ametropic eyes caused—

(1.) An approximation of the far point, which began from the 5th to the 10th minute, reached its maximum from the 7th to the 25th minute, and disappeared from the 40th to the 80th minute. The maximum approximation was equivalent to between 3·15 D. and 8·67 D.

(2.) An approximation of the near point, which began from the 3rd to the 5th minute, reached its maximum from the 12th to the 60th minute, and disappeared in from 8 to 9 hours. The maximum approximation was equivalent to between 4·24 D. and 13·89 D.

(3.) A contraction of the pupil, which began from the 5th to the 15th minute, reached its maximum from the 15th to the 25th minute, and disappeared from the 24th to the 48th hours.

(4.) An increase in the range of accommodation, which began from the 5th to the 10th minute, and was in three cases preceded in the first 7 to 10 minutes, and in two others was interrupted from the 10th to the 45th minute by a decrease. In the remaining case no decrease occurred. The decrease at its maximum varied from 0·73 D. to 3·76 D. The maximum increase occurred from the 42nd to the 80th minute, and varied from 3·76 D. to 9·94 D. The increase disappeared in from 8 to 9 hours.

Taking the average of these results, it seems that eserine caused—

(1.) An approximation of the far point, which began at the 7·33 minute, reached its maximum in 15·67 minutes, and disappeared in 48·67 minutes. The maximum approximation was equivalent to 5·85 D.

(2.) An approximation of the near point, which began in 4·33 minutes, reached its maximum in 26·17 minutes, and disappeared in less than 8 to 9 hours. The maximum approximation was equivalent to 9·15 D.

(3.) A contraction of the pupil, which began in 9·83 minutes, reached its maximum in 20·83 minutes, and disappeared in 24 to 48 hours.

(4.) An increase in the range of accommodation, which began in 6·5 minutes, reached its maximum in 52·67 minutes, and disappeared in 8 to 9 hours. The maximum increase was equivalent to 6·89 D., whilst the average normal range was 8·95 D.; that is, the proportion of the increase to the normal range was 0·77 D. This increase was in three cases preceded in the first 8 minutes, and in two other cases was interrupted between the 10th and 35th minutes by a decrease, which at its maximum was equivalent to 2·26 D.; that is, 0·25 of the normal range.

We have also made a number of controlling observations which, in their general result, confirm the preceding cases.

Generalisation.

We are now in a position to generalise on the action of eserine on non-presbyopic emmetropic and ametropic eyes, but before doing so we desire to refer to the work already published on this subject.

Donders (1) gives a detailed description (with a chart) of the action of extract of Calabar bean on the eye of Mr. Hamer, who had a far point of 48 and a near point of about 5 inches. The drug produced an approximation of the far and near points which reached its maximum in 30 to 40 minutes. The maximum contraction of the pupil occurred about the same time. The far point returned to its normal position in 110 to 120 minutes, but the near point remained approximated and the pupil continued contracted for a much longer time. Thus there was an increase in the range of accommodation preceded by a decrease which seems to have reached its maximum (less than 1·5 D.) in 10 to 20 minutes, whilst the increase attained its maximum (not more than 2 D.) between the 80th and 90th minutes, that is, when the far point was just returning to normal. Donders states that in another case he observed this increase of range without any antecedent diminution. Finally, he says that he has noticed an increased amount of astigmatism whilst determining the position of the near point after the use of eserine.

Von Reuss (27 and 27A) whilst ascertaining the influence of eserine on the radius of the cornea, made numerous measurements of the position of the far point. He found that the maximum effect with a 1 per cent. solution always occurred from the 20th to the 40th minute, and also that "der grösste Brechwerth des eingetretenen scheinbaren Refractions zuwachses betrug $\frac{1}{60}$, $\frac{1}{50}$, $\frac{1}{20}$, $\frac{1}{10}$,

$\frac{1}{9}$, $\frac{1}{7}$, $\frac{1}{5\frac{1}{2}}$, $\frac{1}{4\frac{1}{2}}$, $\frac{1}{4}$, $\frac{1}{3\frac{1}{2}}$, $\frac{1}{3}$, je einmal, $\frac{1}{2\frac{1}{2}}$ zweimal." He does not, however, refer to any alteration in the range of accommodation.

Königstein (26) made some observations on the local action of a 1 per cent. solution of eserine. He found that the influence on the far point had almost passed away in an hour, whilst the approximation of the near point only ceased with the myosis. Therefore indirectly he noticed the increase in the range of accommodation.

Reich (30) found in the case of a man aged 37, who was suffering from paralysis of the accommodation, and whose range was reduced to 3 D., that eserine produced an increase of 4 D. in 30 minutes. He did not, however, investigate its influence on healthy eyes.

Zehender (37) applied a $\frac{1}{2}$ per cent. "Salicylsäuren Physostigmin (eserine)" to the eyes of two of his assistants. He made three sets of observations. In the first he determined the near point by Burchardt's test-dots; in the second he estimated the far point by Burchardt's tests and by glasses, and draws attention to the influence of the narrowed pupil on the visual acuity. He made the third set of measurements of the near point with a Graefe's "stabchen optometer." Zehender prefaces his tables with the following statement: "Die Einwirkung dieses Mittels auf die Accommodation muss dagegen in Abrede genommen, oder mindestens, in Hinblick auf einige die Reinheit, des Versuches störende Momente als zweifelhaft und wiederholter Prüfung bedürftig hingestellt werden." The action of the drug seems to have been very irregular, especially in the eye of his pupil A. (Angelucci), whose far point was sometimes approximated, and sometimes removed to a further point than usual under its influence. No very clear statement as to the alteration of the range occurs in this paper, nor does Zehender's attention seem to have been especially directed to this point.

Krenchel (18) in contrasting the action of physostigmin

and muscarin, says that physostigmin begins by approximating the near point and so increasing the range of accommodation, but stronger action causes the far point to approach.

As far, then, as we can ascertain, no one, since the time of the first and accurate investigation of Donders, has made this a point of special study, and even Donders does not state whether he made observations on different kinds of eyes.

It will be seen from our tables that the near point is obviously affected before the far point. This is confirmatory of Krenchel's observations, but differs from the observation of Donders on the eye of Mr. Hamer. But we find that the maximum approximation of the far point occurred before that of the near point, in this agreeing with Donders' table. The action on the pupil was obviously later than the action on the accommodation, but the maximum contraction of the pupil occurred nearly midway between the times of maximum affection of the far and near points, so that it seems that the time of the maximum affection of the accommodation and pupil were identical. The action on the far point usually ceased within an hour; in this we agree with Königstein, but we differ from him with regard to the time when the influence on the near point ceased. He states that the approximation of the near point only ceased with the disappearance of the myosis, whereas our table shows that the myosis remained for several hours after the effect of the drug on the near point had passed off. On comparing our results relative to the alteration of the range with those of Donders (the only other direct observation on the point we can find), it seems that the increase of the range which occurred in the case of Mr. Hamer bears a very much smaller proportion to its normal range than that which we found to be the average: in fact in none of our cases was the maximum increase as low as that which Donders found in Mr. Hamer's eye. This discrepancy may be accounted for by

the fact that Donders used extract of calabar, and only refers directly to the action of the drug on one eye. With reference to the former point A. Weber (17) writes that "Extract. Calabarense ungefähr 10—15 mal schwächer wirkt als das Eserin."

The action of eserine during the first hour is violent, being characterised by the well-known clonic spasms of the accommodation and by great irregularity in its action, so that the charts only represent the mean result. It is in consequence of this irregularity of action that we feel ourselves unable to endorse the conclusions of Donders relative to the effect of eserine in producing astigmatism, for we know of no apparatus by which both meridians can be measured at the same time, and during the first hour of the action of eserine one cannot be sure that the far or near point will occupy the same position during any two consecutive moments, hence it is quite impossible to accurately compare the measurements taken in one meridian with those taken in another.

Explanation of the Changes in the Range of Accommodation produced by Eserine.

Does eserine cause the change of position of the far point by—

(A.) Altering the shape of the globe; that is, by altering the curve of the cornea?

(B.) By altering the position of the lens?

(C.) By its action on the iris? Or

(D.) By producing cramp of the ciliary muscle?

(A.) The first question to be answered is, What effect does eserine produce on the intraocular tension, and what effect could any tension alteration have on the corneal curve?

Lacqueur (19) and also Lucius (20) found that eserine reduced the tension in glaucoma, but the former says, "Am nicht glaucomatösen Menschenauge sowie am nor-

malen Kaninchenauge habe ich nach wiederholten Physostigmineinträufelungen eine Veränderung des intraocularen Druckes nicht constatiren können." Hippel and Grunhagen (21) could not observe any pressure alteration after the application of eserine; whilst Adamück (5) found that it increased the tension. The observations of A. Weber (17), made with the tonometer on the living eye in man, show that eserine, whilst it diminished the tension in the anterior chamber, raised it in the vitreous.

Pfluger found that eserine first increased and then diminished the tension. Finally Graser (39), after making careful manometric observations on the eyes of living animals, and after reviewing the literature of the subject, concludes that "Eserin, in gleicher (in der gewöhnlich zur Herbeiführung von Myosis gebrauchten Dosis in den Bindehautsack gebracht) Weise angewendet, bedingt zunächst eine Drucksteigerung, der aber in allen Fällen nach Verlauf von spätestens einer Stunde (nachdem sich Myosis entwickelt) eine Druckerniedrigung unter die Norm nachfolgt." The decrease seems in ten cats' eyes to have varied from 4 to 12 mm. Hg. It seems to us that this result renders the earlier want of agreement explicable.

Could this increase cause an alteration of the corneal curve sufficient to account for even a part of the far point approximation? Schelske (2) injected fluid into the enucleated eyes of rabbits and of men, and so raised the intraocular tension. At a certain pressure he found that the cornea became flatter. Donders (3), quoted by Hoffmann, says: "Ein paar Mal haben wir auch den Radius der Hornhaut mit Hülfe des Ophthalmometers an einem glaukomatösen und nicht-glaucomatösen Auge desselben Individuums bestimmt, oder auch den desselben glaukomatösen Auges vor und nach der Operation verglichen, ohne einen bestimmten Einfluss des intraocularen Drucks auf die Wölbung der Cornea erkennen zu konnen." Coccius (4), as quoted by V. Reuss, says: "Selbst in solchen Fällen einseitiger Erkrankung, 'wo hohe Span-

nung, weit vorgerückte Amblyopie, Gesichtsfeldbeschränkung, Druck-Excavation des Sehnerven, Vorhandensein des Arterienpulses,' zu constatiren waren, konnte doch im Vergleich mit dem gesunden Auge keine Krümmungsabweichung gefunden werden; er sucht den Grund hierfür in der Rigidität der Sclerotica. Dagegen konnte er eine Abflachung der Cornea an einem Auge beobachten, an welchem nach Discission einer Cataracta Spannungserhöhung aufgetreten war, und wo sich der Radius der Cornea von 7·75 mm. an 8·20 mm. vergrössert hatte." Mauthner (41) (quoted by Reuss), also found no alteration of the corneal curve in glaucoma, but in an eye with swollen traumatic cataract the corneal radius before the removal of the lens was 8·5 mm., and after its removal it became 7·73 mm. It would therefore seem that if the excessive tension above described could not produce an alteration of the curvature, that the much slighter effect of eserine would also be powerless, but we must now draw attention to a long and elaborate paper by Von Reuss (27A).

With the ophthalmometer of Helmholtz he measured the corneal curve at periodical intervals after the application of eserine. He found generally, but not invariably, that in rough correspondence with the approximation of the far point there was an alteration of the corneal curve (usually diminution of the radius), which disappeared in an hour. He allowed for working errors 0·04 mm. (but Mauthner gives a larger margin), and says: "Es muss vor Allem festgestellt werden, dass die gefundenen Veränderungen nicht innerhalb der Grenzen derselben zu liegen kommen." A careful survey of his tables and charts shows, however, that his results were exceedingly variable, and that there was not an accurate correspondence either in point of time or of quantity between the corneal changes and those of the far point. In fact he himself admits that "die Einwirkung auf die Accommodation findet beinahe immer früher statt, als die auf die

Hornhautwölbung, und das Maximum der Accommodations-Anspannung tritt fast ausnahmslos früher ein, als die grösste Längen-Abnahme des Radius." However, he adds: "Doch liegt die Rückkehr zur Norm bezüglich beider Veränderungen nicht zu weit auseinander, meist ist es beim Radius früher der Fall, selten später oder gleichzeitig." As to the cause of this corneal alteration, he writes further: "Wenn die longitudinalen Fasern (ciliary muscles) sich ad Maximum verkürzen, so werden sie vor Allem die Choroidea nach vorne ziehen und den Glaskörper unter einen erhöhten Druck setzen; es wird dann ein Moment kommen, wo ein weiteres Nachvorneziehen nicht mehr möglich ist, wo leichter eine weitere Retraction der Irisperipherie eintritt, und es wird die Zugrichtung nach hinten aussen zur Geltung kommen." "Die grösste Abnahme betrug einmal 0·04 mm., nach wiederholtem Einträufeln 0·08 mm., einmal 0·07 mm., zweimal 0·09 mm., dreimal 0·10 mm., einmal 0·14 mm., 0·088 mm., 0·099 mm., 0·32 mm." This last result was only found once, and is therefore to be received with reserve. Now it seems to us that this assumption relative to the cause of the alteration of the corneal curve is unwarranted, for the far point is not usually approximated by eserine to the place which the near point occupied before the application, that is to say, that the tension of the ciliary muscle produced by normal accommodation to the near point is usually greater than the tension produced by the application of eserine, and he himself states that the corneal radius does not alter during normal accommodation. Considering the irregularity of his results, the absence of definite information as to the influence of altered intraocular tension on the curve of the cornea, and the want of detailed correspondence between the far point alteration and the change in the corneal curve, it seems that there is room for further investigation on this point.

We have endeavoured to measure the corneal curve before and after the application of eserine by a less elabo-

rate but very convenient method, viz., that recommended by Hirschberg (16, 42): "um die Messung des Hornhautkrümmungsradius zu einer bequemen und schnell ausführbaren Methode der Praxis zu machen, werden in Höhe des zu untersuchenden Auges zwei Lichtflammen aufgestellt, so dass ihre gegenseitige Entfernung 1 m. beträgt und das zu untersuchende Auge vom Mittelpunkt ihrer Halbirungslinie 1 m. entfernt ist. Mit einer Lupe (oder mit dem Pupillometer von Coccius) misst man β, die Grösse der Distanz der beiden Lichtflammen im Spiegelbildchen der Hornhaut, dann ist direct β die Brennweite oder der halbe Krümmungsradius des Hornhautspiegels. Die Untersuchung ist so schnell ausführbar, dass sie ebenso gut wie die Ophthalmoskopie auf jeden Patienten angewendet werden kann, und genau genug, um Abweichungen der Hornhautkrümmung von dem Mittel erkennen zu lassen."

To the eye of a man aged 24, in whom an iridectomy had been performed after an injury, but whose eye had perfectly recovered, we applied eserine solution, having first measured the radius of the cornea. Some time previously we had applied atropine to the eye and had estimated the refraction by retinoscopy: before atropine the vision of the injured eye $= \frac{6}{9}$: by retinoscopy in the meridian of the coloboma (down and out) a $-$ 0·25 lens reversed the shadow, whilst in the opposite meridian a $+1$ D. over corrected.

Under atropine with $\frac{\text{cyl. } -1{\cdot}25 \text{ D. } 30° \text{ out}}{\text{sph. } -0{\cdot}5 \text{ D.}}$ the vision $= \frac{6}{6}$. The far point before the application of eserine, that is when the eye was not under the influence of any drug, was for lines in the axis of the coloboma 250 cm., and for those in the opposite axis 125 cm.: the near points being respectively 10·5 and 10 cm. A careful measurement of the cornea made at this time with all the points

distant 2 metres (instead of 1 to ensure greater absolute accuracy) gave a radius of 7·5 mm. When, after the application of eserine, the far points had both reached 32 cm. and the near points 6·5 cm., on making observations under exactly the same circumstances, we were unable to observe the slightest change in the indicated radius, although whilst accommodating for the near point the tension of the ciliary muscle was greater than under normal circumstances. Now, taking 8 mm. as the normal radius of the cornea and 1·337 as its refractive index and 1 as the index of air, we have $\frac{1{\cdot}337 - 1}{1{\cdot}337} \times \frac{1}{8} = \frac{1}{f}$, where f = the principal focus: from which $\frac{0{\cdot}337}{8} = \frac{1{\cdot}337}{f} + \frac{1}{\infty}$ mm.: $f = 31{\cdot}7$ mm., giving $R = \frac{0{\cdot}337}{0{\cdot}0421} + \frac{1}{\infty}$ where ∞ = the *punctum remotum.* In our case ∞ was 2000 mm. (mean) before the application of eserine, and 320 mm. after. If the cornea alone produced this change there should be a difference between the measurements taken when the far-point was in these two positions of $\frac{0{\cdot}47}{2}$ mm. Since, however, it would have been quite possible for us to have overlooked a change of less than 0·25 mm., we modified the experiment as follows :—We measured the radius of curvature of the L. cornea of C. P. (on whose eyes the action of pilocarpine and eserine is noted in this paper) by fixing the lights as before at 1 metre; this time, however, whilst the observed eye was fixed on a distant object we placed our own eyes whilst making the observation at a definite distance from the observed cornea. We then held a mm. measure as close to the cornea as possible and read off the distance between the centre of the two images. With care we could read to 0·25 mm. It will be remembered that C. P.'s far point was 1000 mm. and his near point 90 mm. We found the radius of his cornea to be 7·5 mm. (this of course not being an absolute value). After a pro-

fuse application of eserine the far point was brought to 200 mm. and the near point to 45 mm. We now made several careful examinations of the cornea in the same manner as before, and also whilst the patient was accommodating to his utmost. We could not, however, find any trace of alteration in the radius. Now if the alteration of the corneal curve had been instrumental in causing the approximation of the far point even (by an application of the preceding formula) there should have been a difference of about 1·04 mm. radius, that is, a difference of 0·5 mm. in our measurements.

However, to conclusively settle the matter we adopted an entirely different plan. We placed over the eye an accurately fitting metal cup with a plane glass front. The cup was filled with warm normal saline solution (0·65 per cent.) and the observed, looking through this bath, practically possessed a plane cornea and was, consequently, highly hypermetropic. It will be seen that this apparatus is only a variety of that used by Coccius in proving that the cornea plays no part in normal accommodation. With this apparatus it was absolutely impossible that changes in the cornea could influence the position of the far or near points.

We applied this apparatus, filled with saline solution, to the left eye of C. P., and the vision was reduced to a dim perception of large objects: on placing a +27 D. lens in front of the glass cornea the vision again $= \frac{6}{6}$. With a +28 D. lens (to bring the far point within a measurable distance) the far point was at 125 cm. and the near point at 14 cm., the vertical meridian only being measured. The apparatus was then removed and eserine profusely applied; after the lapse of eight minutes the apparatus was readjusted exactly as before.

Table of Observations.

Time.	Near point.	Far point.
Before application ..	14 cm.	125 cm.
After application—		
10 minutes	7	40
15 ,, ...	8·5	39
20 ,, ...	7	37
35 ,, ...	8	42
50 ,, ...	9·5	125
55 ,, ...	8	91
60 ,, ...	9	80
65 ,, ...	8	99
70 ,, ...	9·5	105
80 ,, ...	8·5	125

On removing the apparatus the distant vision $= \frac{6}{6}$ and the near point was at 4·5 cm. distance. The irregularity of the observations between the 20th and the 50th minutes was due to sickness which temporarily affected the patient. (*See* also Chart of Case 16.) This table and chart should be compared with Table II.

In this eye eserine caused, when the measurements were taken with the apparatus—

(1.) An approximation of the far point, which began in less than 10 minutes, reached its maximum at the 20th minute, and returned to its normal position practically at the 80th minute. The maximum approximation was equivalent to 1·9 D.

(2.) An approximation of the near point, which began within 10 minutes, reached its maximum at the 10th minute, and remained to a material extent when the observations were discontinued at the 80th minute. The maximum approximation was equivalent to 7·14 D.

(3.) An increase in the range of accommodation, which reached its maximum at the 10th minute, and remained to a material degree at the 80th minute, when the observations were discontinued. The maximum approximation was equivalent to 5·44 D., that is 0·86 of the normal range

6·34 D. (with the apparatus), so that the total range at this time was 11·78 D.

Table showing the Action of Eserine on the Left Eye of C. P.

With the apparatus.		Without the apparatus.	
Time.	Range of accommodation.	Time.	Range of accommodation.
Before application	6·34 D.	*Before application*	12·11 D.
After application 10th minute ...	11·78 D.	*After application* 12th minute	17·76 D.
35th ,, ...	10·12 D.	36th ,, ...	18·81 D.
50th ,, ..	9·73 D.	54th ,, ...	22·05 D. Far point in original position.
80th ,, ...	10·96 D. Far point in original position.	72nd ,, ...	21 D.

From this table it will be seen that before application the range of accommodation with the apparatus was to that without the apparatus as 1 : 1·91. At the only time at which comparisons are again possible, that is, when the far points had returned to the normal position (80th with the apparatus, 54th without), the ratio was 1 : 2·01. It therefore seems that the influence of eserine on the accommodation is relatively the same when a plane cornea is substituted for a curved one.

We made, however, a controlling experiment, XVI*a*. G. L., aged 20, emmetrope V. $= \frac{6}{6}$, near point at 11 cm. When the same apparatus, filled with normal saline solution, was applied to the left eye the vision was reduced to a mere perception of light, and with the aid of a + 23 D. lens, carefully centred, it became $\frac{6}{6}$. With a + 24 D. the far

point was 100 cm. and the near point 16 cm. With a + 25 D. the far point was 47 cm. and the near point 14·5 D. These distances were measured as before from the auxiliary lens. The apparatus was removed, eserine profusely applied, and after a lapse of 6 or 7 minutes it was readjusted. The following table shows the changes in the position of the far and near points produced by the action of eserine:—

Time.	Near point.	Far point.
Before application without apparatus	11 cm.	∞
Before application with apparatus ...	14·5	47 cm.
15 minutes after application with apparatus	15	25
20 minutes after with apparatus.....	11	20
25 minutes after with apparatus.....	11	15
25 minutes after without apparatus ..	9	16

At the 25th minute the observations were discontinued on account of the patient being sick and faint. Nevertheless the table shows—

(1.) The range of accommodation before application was 9·09 D. without the apparatus, and 4·77 D. with it. The ratio of the one to the other being 1 : 0·52.

(2.) At the 25th minute the range of accommodation was 4·86 D. without the apparatus, and 2·42 D. with it: the ratio of the one to the other being 1 : 0·49.

Since then we have been unable to observe any alteration in the corneal radius following the application of eserine, and since we have been unable to notice any material difference in the extent to which the near and far points were altered in position by the eserine when a plane was substituted for a curved cornea (that is relatively, for the alteration of the position

of the nodal point necessarily alters the extent of range), we therefore conclude "that this alteration of the corneal radius, which Von Reuss has described with such minuteness and care, is neither a constant nor necessary accompaniment to the change in the range of accommodation; and that the influence the cornea exerts in the approximation of the far or the near point, if it constantly exists, is very trivial." Indeed, we further think it probable that the alterations he describes have some other source than the contraction of the ciliary muscle.

(B.) Can the change in the range of accommodation be due to an alteration in the position of the lens?

To this question we find ourselves unable to give a definite reply; for although we believe that we may state positively that no movement of translation of the lens takes place normally in accommodation; and although we feel that we are justified in asserting that the whole of the increase produced by eserine is not due to any movement of the lens, yet we are unable to make a positive statement that no movement of the lens occurs and that no part of the increase is due to any such movement: on the other hand we are unable to say such a movement takes place. Some slight forward movement of the lens is more than possible, since A. Weber (17) found that the contraction of the iris raises the tension in the vitreous whilst it diminishes that in the anterior chamber, thus confirming, we believe, Helmholtz's calculation. Since with an advance of the lens the nodal point of the dioptric system is also advanced, it is evident that any alteration in the curve of the lens will now produce a greater effect than formerly.

That increased posterior tension will produce a forward movement of the lens is sufficiently proved by the pathology of glaucoma; on the other hand the increased tension in the vitreous resulting from the application of eserine is hardly even for argument's sake to be compared with that in glaucoma. Therefore we are com-

pelled to close this discussion with the following statement:—

"A forward movement of the lens may be produced by eserine and this may contribute slightly to the alteration in the position of the far and near points."

(C.) Can the great contraction of the sphincter pupillæ which eserine causes have any influence in producing the changes in the position of the far and near points?

It is very difficult to understand in what manner this could exert any influence. In Hjort's case there was no iris and the changes in the position of the far and near points were well marked; in our own case of iridectomy the functional destruction of the iris did not influence the result, and further, since the far point approximates and recedes without any reference to the iris-contraction, and the near point returns to normal before the pupil has returned to its normal size, it seems to us that there is not the least evidence to support such a view, and we therefore feel able to make this positive statement: "the contraction of the iris has no appreciable influence on the accommodative changes produced by eserine."

(D.) It might seem sufficient to state that having proved that the other factors do not produce the change in the range of accommodation, the ciliary muscle is the only structure which can effect them. But it is now our intention to endeavour to show that there is direct evidence of the action of eserine on the accommodative apparatus. We think that we are justified in taking it as proved "that accommodation for the near is effected by the contraction of the ciliary muscle, which draws forward the ciliary processes, relaxes the suspensory ligament, and allows the anterior surface of the lens to become more convex." What evidence is there, then, that the application of eserine can produce this change?

Professor O. Becker (6), quoted by Hjort, found—

"(1.) Dass die Ciliarfortsätze ein mit der Weite der Pupille wechselndes Volumen zeigen, indem sie gegen die

Sehaxe vorrücken wenn die Pupille sich beim Sehen in die Ferne oder auf Atropin erweitert, sich aber gegen den Ciliarkörper zurückziehen wenn die Pupille sich bei Accommodations-Anspannung oder auf Calabarextract verengert.

"(2.) Dass die Ciliarfortsätze niemals die Linse berühren.

"(3.) Dass bei Accommodation für die Nähe und bei Einlegen von Calabarpapier der schwarze Linsenrand breiter, bei Entspannung des Auges und Einträufeln von Atropinlösung schmäler wurde, was sich nur durch eine Abstumpfung und Zuschärfung des Linsenrandes erklären lässt."

Hjort (14), however, had a splendid opportunity of observing the changes in the position of parts in a patient whose iris had completely disappeared in consequence of a dynamite explosion, the eye being otherwise uninjured. The range of accommodation was in no wise affected by the injury, but it was a little more myopic than its fellow. Hjort, after making some careful observations, writes as follows: "Bei Calabareinwirkung zeigte sich eben dasselbe (as by accommodation for 6 or 8 inches), nur in sehr viel auffallenderer Weise. Die Ciliarfortsätze traten während der Nähe-Accommodation so stark hervor, dass man an einzelnen Stellen den Boden der zwischenliegenden Furchen sehen konnte, der Linsenrand wurde deutlich breiter, während der Abstand derselben von den Spitzen der Ciliarfortsätze ungeändert erschien . . . Während der stärksten Calabareinwirkung (nach 30 Minuten) zeigte sich der Fernpunkt von 28 bis 6 Zoll hereingerückt. He found that during normal accommodation for 6 or 8 inches—

"(1.) Der schwarze Linsenrand wurde sichtbar breiter.

"(2.) Die Ciliarfortsätze rückten hervor, der Augenachse näher, und schienen gleichzeitig zu schwellen.

"(3.) In dem Abstand zwischen Linsenrand und Spitze der Ciliarfortsätze (Zonularraum) konnte keine Aenderung beobachtet werden."

In two albinos in whom eserine, locally applied, produced the most profound myosis, Hjort confirmed this alteration of the position of the ciliary processes during accommodation and during the action of eserine. He says that Becker's failure to see this change was accounted for by his not using calabar, which exaggerates the normal changes. We desire to lay particular stress on the fact that Hjort could not distinguish between the action of calabar and normal accommodation, except that with calabar the changes were more marked, that is, the difference was one of quantity only.

Bauerlein (15) made similar observations on eight albinos and on many iridectomied eyes, and confirmed Hjort's statements, whilst A. Weber (17) goes almost further. Thus, he says: "Mit vollständiger Evidenz ist am iridectomirten Auge nach Anwendung von Calabar zu sehen, dass die Ciliarfortsätze nicht nur weit hervorrücken, sondern auch so mächtig anschwellen dass sie sich in dem Zwischenraum des Coloboms nach aussen umschlagen und so über das Niveau der Irisfläche hervorwölben . . . Dass aber die Turgescenz nicht die einzige Ursache des Sichtbarwerdens resp. des deutlicheren Hervortretens der Ciliarprocesse ist, sondern dass wirklich ein Vorrücken derselben statt hat, davon hatten wir, abgesehen von der aprioristischen Annahme, einmal einen unzweideutigen Beweis: an diesem Auge sah man die aus den Interstitien zwischen je zwei Processus fächerartig sich ausbreitenden Büschel ganz leicht getrübter Zonulafasern, die vor der Calabar-Anwendung alle deutlich vom Linsenrande her nach hinten zogen, nach eingetretener Calabarwirkung im seitlichen Theil des Coloboms horizontal im mittleren Theile, wo die Ciliarfortsätze nach aussen umgeschlagen waren, von der Linse gegen die Peripherie sogar etwas nach vorne verlaufen."

The evidence of these three observers, Hjort, Bauerlein, and A. Weber, seems to us conclusive that the action of eserine is to produce the identical changes which occur in accommodation for a near object.

Coupling this with our own results, obtained whilst measuring the corneal curve in order to eliminate the supposed influence of the cornea on the position of the far point, we are enabled to conclude that—The change in position of the far and near points which eserine produces, and the consequent alteration in the range of accommodation, must be referred chiefly, if not entirely, to changes produced by the eserine in the ciliary muscle itself, since it has been shown that neither the changes in the iris nor the cornea, nor an alteration in the position of the lens, could produce more than a fractional part of the change, and also since the influence of the first two factors can be, at all events sometimes, entirely eliminated.

Having then localised the action of eserine to the accommodation apparatus, it remains for us to consider what is the nature of that action. In the later stage, when the far point has receded and the near point remains materially approximated, and the range of accommodation is thus increased, it is evident that eserine has acted like strychnia (Donders), and we have to deal with some change in the muscle which causes it to respond more powerfully than usual to volitional impulses. The probable meaning of the first approximation of the far point is that eserine at first causes a spasm (accommodationskrampf) with increased response to volitional impulses, and that the first effect passes off the more rapidly of the two.

The Action of Eserine on Presbyopes.

So far as we can ascertain, no reference to this point is to be found in any preceding paper.

CASE VII.—C. B., æt. 50. *Right Eye.* V. $= \frac{6}{18}$. Hm. 2 D. $= \frac{6}{6}$.

Moderate Application. Position of the Near Point Estimated in Vertical Meridian only. Position of Far Point Estimated by means of Glasses and Snellen's Types.

Time.	Pupil.	Near point.	Far point.
Before application.....	3·5 mm.	42 cm.	− 50 cm.
After application—			
5 minutes.....	3·5	36	0
10 „	2	26	200
15 „	2	15	200
20 „	2	9·5	200
25 „	2	7	40
35 „	2	7·5	40
40 „	2	7	66
50 „	2	7	66
55 „	2	7·5	66
60 „	2	7·5	0
65 „	2	7·5	0
70 „	2	7·5	0
80 „	2	7·5	0
90 „	2	7·5	0
95 „	2	10	−133

After the pupil became contracted, whether in consequence or not we cannot say, the distant vision was not very good even with correcting glasses $\left(\text{V.} = \frac{6}{9} \text{ instead of } \frac{6}{6}\right)$. Towards the end of the observation, however, the sharpness of vision returned though the pupil was still contracted.

In this eye eserine caused—

(1.) An approximation of the far point, which began at the 5th, reached its maximum at the 25th, and had nearly passed away at the 95th minute. The maximum approximation was equivalent to 4·5 D.

(2.) An approximation of the near point, which began at the 5th minute, reached its maximum at the 25th minute, and remained greatly approximated at the 95th

minute, when the observations were discontinued. The maximum approximation was equivalent to 11·91 D.

(3.) A contraction of the pupil, which began and reached its maximum between the 5th and 10th minute, and remained to the same degree at the 95th minute, when the observations were discontinued.

(4.) An increase in the range of accommodation, preceded in the first 10 minutes by a decrease which at its maximum amounted to 1·6 D.; that is, nearly a third of the normal range (4·38 D.). The increase reached its maximum at the 60th minute, and at that time amounted to 8·95 D., that is, to double the normal range, so that the range was then 13·33 D. The increase was still great at the 95th minute. (*See* Chart.)

Case VIII.—*Left Eye* of Same Patient. Moderate Application. V. same as in Right.

Time.	Pupil.	Near point.	Far point.
Before application..	3·5 mm.	42 cm.	− 50 cm.
After application—			
5 minutes	3·5	32	−133
10 „	2	22	−200
15 „	2	11	−400
20 „	2	7	66
25 „	2	6·5	66
35 „	2	6	66
40 „	2	6	100
50 „	2	6	66
55 „	2	6·5	200
60 „	2	7	−400
65 „	2	..	−400
70 „	2	7	−200
80 „	2	7	−200
90 „	2	..	−200
95 „	2	9	−100

At this time with both eyes the Hm. = 1·5 D. In this eye the distant vision remained (with glasses) good throughout $\left(\frac{6}{6}\right)$.

In this eye eserine caused—

(1.) An approximation of the far point, which began at the 5th, reached its maximum at the 20th, and had nearly passed away at the 95th minute. The maximum approximation was equivalent to 3·52 D.

(2.) An approximation of the near point, which began at the 5th, reached its maximum at the 35th, and remained to a great extent at the 95th minute, when the observations were discontinued. The maximum approximation was equivalent to 14·29 D.

(3.) A contraction of the pupil, which began and reached its maximum between the 5th and 10th minutes, and remained to the same degree at the 95th minute.

(4.) An increase in the range of accommodation, preceded in the first 5 minutes by a decrease which at its maximum was 0·51 D. The increase reached its maximum at the 40th minute, and at that time was 11·29 D., that is, about 2·5 times the normal range (4·38 D.), so that the range was then 15·67 D. The increase was still considerable at the 95th minute.

Case IX.—E. P., æt. 60. *Left Eye.* Profuse Application.

$$V. = \frac{6}{60}. \quad Hm.\ 2\ D. = \frac{6}{6}.$$

Time.	Pupil.	Near point.	Far point.
Before application..	3·5 mm.	56 cm.	– 50 cm.
After application—			
5 minutes	3	35	An endeavour was
10 „	2	37	made to estimate
15 „	1·5	25	the far point with
20 „	1 5	30	the optometer, but
25 „	1·5	28	the results were
30 „	1·5	34	wholly unsatisfac-
35 „	1·5	40	tory, irregular, and
45 „	1·5	40	unreliable.

It will be seen that in this case eserine caused a very trivial approximation of the near point, that is, only 1·5 D.

even at its maximum, and that this effect rapidly passed away. What the effect on the far point was we cannot definitely state, and therefore the alteration in the range also cannot be given, but it is nearly certain that it was decreased, and but slightly if at all subsequently increased.

In this case eserine caused- -

(1.) An approximation of the near point, which began at the 5th minute, reached its maximum at the 15th, and still existed to some extent at the 45th minute. The maximum was equivalent to 2·21 D.

(2.) A contraction of the pupil, which began at the 5th and reached its maximum at the 15th minute, and remained in this condition at the 45th minute, when the observations were discontinued.

Case X.—M. C., æt. 53. *Left Eye.* V. $= \frac{6}{60}$. Hm. 2 D. $= \frac{6}{6}$.

Profuse Application.

Time.	Pupil.	Near point.	Far point.
Before application..	3·5 mm.	60 cm.	= 50 cm.
After application—			
5 minutes	3	36	150
10 „	2·5	18	50
15 „	2	8	45
20 „	2	6	42
25 „	2	5	55
30 „	2	5	65
35 „	2	5	Nearly normal, that is, beyond reach of measurement with the optometer.
40 „	2	5·5	
45 „	2	5·5	

In this case eserine caused—

(1.) An approximation of the far point, which began at the 5th, reached its maximum at the 20th, and disappeared probably between the 40th and 50th minutes. The maximum approximation was equivalent to 4·38 D.

(2.) An approximation of the near point, which began at the 5th, reached its maximum at the 25th, and remained

to a considerable degree at the 45th minute, when the observations were discontinued. The maximum approximation was equivalent to 18·33 D.

(3.) A contraction of the pupil, which began at the 5th, reached its maximum at the 15th, and remained to the same degree at the 45th minute.

(4.) An increase in the range of accommodation, preceded in the first 10 minutes by a decrease which was 1·56 D. The increase reached its maximum at the 40th minute, and at that time was 16·52 D., that is, nearly five times the normal range (3·67 D.), so that the range was then 20·18 D. The increase was still considerable at the 45th minute.

Case XI.—E. D., æt. 49. *Left Eye.* V. $= \frac{6}{24}$. Hm. 1·5 D. $= \frac{6}{6}$.

Profuse Application.

Time.	Pupil.	Near point.	Far point.
Before application..	4·5 mm.	23 cm.	− 66·6 cm.
After application—			
5 minutes	4	18	− 66·6
10 „	2·5	14	125
15 „	2	11	125
20 „	2	11·5	86
25 „	2	11	66
30 „	2	11·5	90
35 „	2	12	100
40 „	2	12	−100
45 „	2	12·5	−100
50 „	2	13·5	− 66·6
60 „	2	14	
80 „	2	17	

The far point observations were taken partly by the optometer and partly by the test types and glasses.

In this eye eserine caused—

(1.) An approximation of the far point, which began at the 10th, reached its maximum at the 25th, and disappeared at the 60th minute. The maximum approximation was equivalent to 3·02 D.

(2.) An approximation of the near point, which began at the 5th, reached its maximum at the 15th, and remained to a considerable degree at the 80th minute, when the observations were discontinued. The maximum approximation was equivalent to 4·74 D.

(3.) A contraction of the pupil, which began at the 5th, reached its maximum at the 15th, and remained to the same degree at the 80th minute.

(4.) An increase of the range of accommodation, which reached its maximum at the 40th minute, and at that time was 3·48 D., that is, more than half the normal range (5·85 D.), so that the range was then 9·33 D. The increase was still considerable at the 80th minute.

Case XII.—E. F., æt. 51. *Right Eye.* V. $= \frac{6}{6}$. Hm. 0·5 D.

Profuse Application.

Time.	Pupil.	Near point.	Far point.
Before application..	4·5 mm.	65 cm.	−200 cm.
After application—			
5 minutes	4	49	125
10 „	2·5	34	95
15 „	2	20	95
20 „	2	30	70
25 „	2	30	85
30 „	2	29	94
35 „	2	30	96
40 „	2	30	96
45 „	2	30	100
55 „	2	35	100
70 „	2	32	125
85 „	2	33	150
100 „	2	30	Apparently normal.
110 „	2	30	−200

In this case also the far point was estimated both with glasses and with the test types, but at the end of the observations, and in fact earlier also, it was at times very difficult to obtain vision of more than $\frac{6}{9}$ even with correcting glasses. In this eye eserine caused—

(1.) An approximation of the far point, which began at the 5th, reached its maximum at the 20th, and disappeared at the 100th minute. The maximum approximation was equivalent to 1·93 D.

(2.) An approximation of the near point, which began at the 5th, reached its maximum at the 15th, and remained to a considerable extent at the 110th minute, when the observations were discontinued. The maximum approximation was to 3·46 D.

(3.) A contraction of the pupil, which began at the 5th, reached its maximum at the 15th, and remained to the same degree at the 110th minute.

(4.) An increase in the range of accommodation, preceded in the first 10 minutes by a decrease which was 0·79 D., that is, nearly half the normal range (2·04 D). The increase reached its maximum at the 15th minute, and was at that time 1·91 D., that is, nearly equal to the normal range, so that the range was then 3·95 D. From the 20th to the 55th minutes the range was practically normal; from the 70th to the 110th an increase was again noticeable, which at its maximum (110th minute) was 1·79 D. (*See* Chart.)

Case XIII.—A. R., æt. 51. *Right Eye.* V. $= \frac{6}{6}$. Hm. 0·5 D.

Time.	Pupil.	Near point.	Far point.
Before application..	5 mm.	65 cm.	−200 cm.
After application—			
5 minutes	4·5	52	125
10 „	3·5	35	70
15 „	3	22	40
20 „ ...	2·5	10	30
25 „	2	9	34
30 „ ...	2	9	22
35 „	2	9	35
40 „	2	11	30
45 „	2	9	30
50 „	2	9	30
55 „	2	10	34
60 „	2	9	30
65 „	2	9	35
70 „	2	8·5	30
75 „	2	9·5	50
80 „	2	10	52
85 „	2	9	50
90 „	2	8·5	54
95 „	2	10·5	55
100 „	2	9	55
105 „	2	9	60
110 „	2	9	60
120 „	2	8·5	60
130 „	2	9	70
145 „	2	9	77
155 „	2	..	75

The far point in this case was estimated partly by the optometer and partly by test glasses. In this case eserine caused—

(1.) An approximation of the far point, which began at the 5th, reached its maximum at the 30th, and had not altogether disappeared at the 155th minute. The maximum approximation was equivalent to 5·05 D.

(2.) An approximation of the near point, which began at the 5th, reached its maximum practically at the 25th (the actual lowest measurement was at the 70th, 90th, and 120th minutes, but the increased approximation was trivial), and remained to a great degree at the 145th

minute, when the observations were discontinued. The maximum approximation was 10·22 D.

(3.) A contraction of the pupil, which began at the 5th, reached its maximum at the 25th, and remained to the same degree at the 155th minute.

(4.) An increase in the range of accommodation, preceded in the first 15 minutes by a decrease, which was 1·01 D., that is, nearly half the normal range 2·04 D. The increase reached its maximum at the 120th minute, and was at that time 8·05 D., that is, more than four times the normal range, so that the range then was 10·09 D. The increase was still great at the 155th minute.

Case XIV.—E. H., æt. 65. *Right Eye.* V. $= \frac{6}{60}$. Hm. 4·5 D. $= \frac{6}{6}$.

Profuse Application. Far Point Estimated by Test Types.

Time.	Pupil.	Near point.	Far point.
Before application..	5 mm.	70 cm.	Hm. 4·5
After application—			
5 minutes	3·5	60	
10 „	3	13	Hm. 1·5
15 „	2	10	
20 „	2	10	Hm. 2
25 „	2	10	
30 „	2	9	Hm. 2
35 „	2	9	
40 „	2	9	Hm. 1·5 D.
50 „	2	..	Hm. 1·5 D.
55 „	2	10	
60 „	2	12	Hm. 2·5
70 „	2	10	
85 „	2	9	Hm. 3 D.

In this case eserine caused—

(1.) An approximation of the far point, which reached its maximum at the 10th minute, and existed still to a slight extent at the 85th minute. The maximum increase was equivalent to 3 D.

(2.) An approximation of the near point, which began at the 5th, reached its maximum at the 30th, and was

in that condition at the 85th minute. The maximum approximation was equivalent to 9·68 D.

(3.) A contraction of the pupil, which began at the 5th, reached its maximum at the 15th, and remained in that condition at the 85th minute, when the observations were discontinued.

(4.) An increase in the range of accommodation, which reached its maximum at the 85th minute. The increase at its maximum was equivalent to 8·18 D., that is, more than equal the normal range (5·93 D.), so that the range was then 14·11 D. (*See* Chart.)

CASE XV.—*Left Eye* of Same Patient. V. $= \frac{6}{60}$. Hm. 4·5 D. $= \frac{6}{6}$.

Application and Method as in R.

Time.	Pupil.	Near point.	Far point.
Before application..	5 mm.	70 cm.	Hm. 4·5 D.
After application—			
5 minutes	4	50	
10 ,, ...	3	7	Hm. 1·5 D.
15 ,, ...	2 (Oval horizontally)	5	
20 ,, ...	2	6	Hm. 1·5 D.
25 ,, ...	2	5·5	
30 ,, ...	2	6	Hm. 2·5 D.
35 ,, ...	2	9	
40 ,, ...	2	9	Hm. 2·5 D.
50 ,, ...	2	8	Hm. 3 D.
55 ,, ...	2	8	
60 ,, ...	2	6	Hm. 3·5 D.
70 ,, ...	2	8	Hm. 3 D.
85 ,, ...	2	7	Hm. 3·5 D.

In this eye eserine caused—

(1.) An approximation of the far point, which reached its maximum at the 10th, and had almost disappeared at the 85th minute, when the observations were discontinued. The maximum approximation was equivalent to 3 D.

(2.) An approximation of the near point, which began at the 5th, reached its maximum at the 15th, and existed

still to a great extent at the 85th minute. The maximum approximation was equivalent to 18·57 D.

(3.) A contraction of the pupil, which began at the 5th, reached its maximum at the 15th, and remained in that condition at the 85th minute.

(4.) An increase in the range of accommodation, which reached its maximum at the 15th minute, and existed to nearly the same degree at the 85th minute. The maximum increase was 15·57 D., that is, more than 2·5 times the normal range (5·93 D.), so that the total range was then 21·5 D.

We have also applied eserine to the eye of a myope, aged 47, and we found that it caused an increase in the range of accommodation preceded by a slight diminution. Other controlling observations on presbyopic eyes have given results agreeing in the main, though differing in detail, with those recorded.

Summary.

We have given a detailed account of the action of eserine on the eyes of old people, in which the near point had receded respectively to 42, 42, 56, 60, 23, 65, 65, 70, 70 centimetres. All these eyes were hypermetropic, but two to the extent of 0·5 D. only, or practically emmetropic.

In these eyes eserine caused—

(1.) An approximation of the far point, which began from the 5th to the 10th minute, reached its maximum from the 10th to the 30th minute, and disappeared from the 40th to later than the 155th minute. The maximum approximation was equivalent to from 1·93 D. to 5·05 D.

(2.) An approximation of the near point, which began at the 5th minute, reached its maximum from the 15th to the 35th minute, and then was equivalent to from 2·21 D. to 18·57 D.

(3.) A contraction of the pupil, which began from the 5th to the 10th minute, reached its maximum from the 10th to the 25th minute, and was in this condition when

the observations were discontinued, that is, from the 45th to the 155th minute.

(4.) An increase in the range of accommodation, preceded in 5 cases by a decrease during the first 5 to 15 minutes, which at its maximum was equivalent to from 0·51 D. to 1·6 D. The increase reached its maximum from the 15th to the 120th minutes, and then amounted to from 1·91 D. to 16·52 D., or from rather more than half to nearly five times the normal range.

Taking the average of these results, it is seen that eserine caused—

(1.) An approximation of the far point, which began in 5·83 minutes, reached its maximum in 20 minutes, and was then equivalent to 3·58 D.

(2.) An approximation of the near point, which began in 5 minutes, reached its maximum in 22·22 minutes, and was then equivalent to 10·38 D.

(3.) A contraction of the pupil, which began in 5·55 minutes, and reached its maximum in 15 minutes.

(4.) An increase in the range of accommodation, preceded in five cases by a decrease in the first 10 minutes, which amounted at its maximum to 1·09 D., that is, 0·33 of the average normal range of these five cases. The increase was 9·24 D., that is, 2·16 times the average normal range, which was 4·28 D. The maximum increase occurred at the 51·9 minute.

A reference to the following table shows—

(1.) That the commencement of the action and the time of maximum action on the far point were much the same in both presbyopic and non-presbyopic eyes. The amount of approximation, however, was greater in the case of the non-presbyopic eye.

(2.) That the commencement of the action and the time of maximum action on the near point were also much the same in both presbyopic and non-presbyopic eyes, but that the amount of approximation was a little greater in the presbyopic eyes.

(3.) The commencement of the action and the time of maximum action on the pupil seem to have occurred later in the non-presbyopic eyes.

(4.) The time of maximum increase of the range of accommodation was almost exactly the same in both cases. The absolute and relative amount of increase was greater in the presbyopic eye, although the total range at the time of maximum increase was greater in the non-presbyopic eye.

Basing, then, a conclusion on these average results, it seems that the chief difference between the action of eserine on the eyes of old and young people are—

(1.) That in presbyopic people the far point is not approximated so greatly, and (2) that the near point is approximated to about the same absolute, that is, to a greater relative extent.

The average result of the action of eserine on the 15 presbyopic and non-presbyopic eyes was—

(1.) An approximation of the far point, which began at the 6·58 minute, reached its maximum at the 18·14 minute, and passed away at the 55·22 minute. The maximum approximation was equivalent to 4·54 D.

(2.) An approximation of the near point, which began at the 4·73 minute, reached its maximum at the 23·8 minute, and was at its maximum equivalent to 9·89 D. The approximation of the near point disappeared in 8 to 9 hours.

(3.) A contraction of the pupil, which began at the 7·27 minute, reached its maximum at the 17·33 minute, and disappeared in from 24 to 48 hours.

(4.) An increase in the range of accommodation, preceded in eight cases—in the first 9·25 minutes, and interrupted in two others, 10—35 minutes—by a decrease of the range, which at its maximum was 1·68 D., or 0·26 of the normal range of these 10 cases. The increase of the range reached its maximum at the 52·22 minute, it was then 8·24 D., that is, 1·31 of the normal range (6·28 D.).

It is noteworthy that the maximum action on the pupil occurred before the maximum action on the accommodation.

It is evident that these presbyopic eyes may be divided into two groups, viz., those in which the range of accommodation was greatly increased (Nos. 8, 10, 13, 14, 15), and those in which the near point was not very much approximated, and consequently the range was not very much increased (Nos. 9, 11, 12).

The cause of this variability cannot lie in the age of the patients nor in the refractive character of the eyes, since eserine caused very great increase in the range of accommodation of older eyes with similar refraction. On dilating the pupils of a woman aged 55, whose V. $= \frac{6}{6}$ but whose range was only slightly increased by eserine, we found numerous cortical striæ in the periphery of the lens and also some haziness in the nucleus. It seemed to us that this would account for the peculiarity, but on applying the drug to the eye of another patient aged 55, with V. $= \frac{6}{12}$ Hm. 0·75 D., a marked increase in the range resulted; on dilating the pupil we found, however, rather more opacity than in the preceding case. We concluded that if the opacity is the index of the amount of rigidity the lens possesses, then the rigidity does not materially affect the action of eserine.

It seems to us that these observations on the eyes of old people throw some light on the causation of presbyopia; for if eserine by causing a contraction of the ciliary muscle can produce this increase in the range, it seems improbable that presbyopia can be dependent to any great extent on rigidity of the apparatus; for if the failure of the accommodation is due to lens rigidity it would appear to be quite impossible (in the present state of knowledge) that this contraction could cause an increase of lens convexity. That is to say, the muscle simply allows the lens

to become more convex by relaxing the strain on the suspensory ligament, and if the lens were rigid no amount of relaxation of the suspensory ligament could bring about increased lens convexity. This view was supported to some extent by some experiments made by one of us at an earlier date. In the paper recording those experiments the following statement occurs:—"If presbyopia were in great measure due to rigidity of the apparatus and not to failure of the ciliary muscle, it would be expected that the relaxation periods of C. (who was æt. 35, emmetropic, near point 18 cm.) would be fairly long, but although the relaxation velocity, from 33 cm. to infinity, was fairly long, all others were too rapid for measurement;" that is to say, no difference in the velocity of accommodation was observed in the case of a man aged 35 with a near point of 18 cm., and in the case of two people aged 19 and 22 respectively whose near points were 9 cm. and 11 cm., far points −100 cm. and −200 cm., and whose accommodation velocities, from the far to the near, were much more rapid than those of C. These facts appear to suggest that the failure of the ciliary muscle may account for some part of the presbyopic accommodative change, but it must be remembered that this statement depends on the assumption that Helmholtz's theory of the mechanism of accommodation is correct.

Table Showing the Results of the Application of Eserine to Presbyopic and Non-presbyopic Eyes (Averages).

	Far point.		Near point.		Pupil.		Increase of range.		Decrease of range.	
	Presbyopes.	Non-presbyopes.	Presbyopes.	Non-presbyopes.	Presbyopes.	Non-presbyopes.	Presbyopes.	Non-presbyopes.	Presbyopes.	Non-presbyopes.
Commencement of action	5·83 min.	7·33 min.	5 min.	4·33 min.	5·55 min.	9·83 min.				
Time of maximum action..	20 „	15·67 „	22·22 „	26·17 „	15 „	20·83 „	51·87 min.	52·67 min.		
Amount of maximum action	3·58 D.	5·85 D.	10·38 D.	9·15 D.	..	..	9·24 D. or 2·16 of the normal range (4·28)	6·89 D. or 0·77 of the normal range (8·95)	1·09 D. or 0·33 of the normal range	2·26 D. or 0·25 of the normal range

II. *The Action of Pilocarpine on the Range of Accommodation of Emmetropes and Ametropes.*

We have always used a 1 per cent. solution of pilocarpine which was clear and transparent, and have applied it profusely to the eyes examined.

Case XVI.—C. P., æt. 19. A Hypermetrope on whose Eyes the Action of Eserine has been already recorded. *Right Eye.* Vertical Meridian only.

Time.	Near point.	Far point.
Before application..	9 cm.	−100 cm.
After application—		
5 minutes	9	−100
10 „	9	
15 „	9	
20 „	8·75	
25 „	7·25	200
30 „	7·25	100
35 „	6·5	75
40 „	6·75	96
45 „	6·5	250
50 „	6·75	Nearly normal.
55 „	7·25	
60 „	7	
70 „	7	
90 „	8	
120 „	8·5	
190 „	8	

In this case pilocarpine caused—

(1.) An approximation of the far point, which began at the 25th minute, reached its maximum at the 35th minute, and returned to its normal position at the 50th minute. The maximum approximation was equivalent to 2·33 D.

(2.) An approximation of the near point, which began at the 20th minute, reached its maximum at the 35th, and still existed at the 190th minute. The maximum approximation was equivalent to 4·27 D.

(3.) An increase in the range of accommodation, which began at the 15th minute, reached its maximum at the

60th minute, and still remained to a slight extent at the 190th minute. The maximum increase was 3·18 D., so that it was 0·26 of the normal range (12·11 D.).

This table and chart should be compared with Chart I.

Case XVII.—C. P. *Left Eye.* Vertical Meridian only. Very Profuse Application.

Time.	Near point.	Far point.
Before application..	9 cm.	−100 cm.
After application—		
5 minutes	9	−100
10 „	9	−100
15 „	7	150
20 „	6·5	100
25 „	5·5	82
30 „	6	88
35 „	6	88
40 „	6	200
45 „	6	250
50 „	5·5	Nearly normal.
55 „	5·5	
60 „	5·5	
65 „	5·5	
80 „	5·5	
95 „	6	
115 „	6·5	

In this case pilocarpine caused—

(1.) An approximation of the far point, which began at the 15th minute, reached its maximum at the 25th minute, and disappeared at the 50th minute. The maximum approximation was equivalent to 2·22 D.

(2.) An approximation of the near point, which began at the 15th minute, reached its maximum at the 25th minute, and still existed at the 115th to some degree. The maximum approximation was equivalent to 7·07 D.

(3.) An increase in the range of accommodation which was first manifest at the 15th minute, reached its maximum at the 55th minute, and existed to a considerable degree at the 115th minute, when the observations were discontinued. The maximum increase was equivalent to 7·07 D.,

that is 0·58 of the normal range (12·11 D.), so that at this time the total range was 19·18 D. (*See* Chart.)

Case XVIII.—J. W. B. *Left Eye.* Action of Eserine on this Eye already recorded (p. 135).

Time.	Pupil.	Near point.	Far point.
Before application..	4 mm.	11 cm.	−200 cm.
After application—			
5 minutes	4	11	−200
10 „	4	8·5	−200
15 „	3	9	73
20 „	2·5	7·75	60
25 „	2·25	8	45
30 „	2	8	43
35 „	2	7·5	41
40 „	2	8·25	70
45 „	2·25	8	63
50 „	2	8	70
55 „	2	8	85
65 „	..	8	200
70 „	..	8	Over 200 V. = $\frac{6}{6}$ partly.
130 „	3	9·5	

About the 20th minute a singular phenomenon occurred; the vision with the right eye = $\frac{6}{6}$, and with the left $\frac{6}{36}$; but if both eyes were opened together "the observed" could alternately see $\frac{6}{6}$ and $\frac{6}{36}$; if whilst the test types were being looked at by the left eye only the right eye was suddenly uncovered an appreciable time elapsed before perfect vision $\left(\frac{6}{6}\right)$ was obtained. The explanation of this phenomenon would seem to be that a reflex contraction of the right ciliary muscle, resulting from the contraction in the left eye caused by the action of the drug, had to be overcome by a volitional impulse before good distant vision could be obtained.

In this case pilocarpine caused—

(1.) An approximation of the far point, which began at the 15th minute, reached its maximum at the 35th minute, and disappeared at the 70th minute. The maximum approximation was equivalent to 2·94 D.

(2.) An approximation of the near point, which began at the 10th minute, reached its maximum at the 35th minute, and at the 130th minute had nearly reached its original position. The maximum approximation was equivalent to 4·24 D.

(3.) A contraction of the pupil, which began at the 15th minute, reached its maximum at the 30th minute, and had not disappeared at the 130th minute, when the observations were discontinued.

(4.) An increase in the range of accommodation, which began at the 10th minute, reached its maximum at the 70th minute, and still existed at the 130th minute. The maximum increase was 2·91 D., that is 0·3 of the normal range (9·59 D.), so that the total range was then 12·5 D.

CASE XIX.—W. L., Myope, æt. 32. Vertical Meridian only. *Right Eye.* Profuse Application.

Time.	Pupil.	Near point.	Far point.
Before application..	3·5 mm.	10 cm.	23 cm.
After application—			
5 minutes	3·5	10	23
10 „	3·5	10	17
15 „	2·5	9·5	12
20 „	2	9	11·5
25 „	..	9·5	11·5
30 „	..	9	11
35 „	..	9	11
40 „	..	9	11
45 „	..	9·5	12
50 „	..	..	12
55 „	..	9	14
60 „	..	9·5	14·5
70 „	..	9·5	14
75 „	..	9·5	18
80 „	..	10	17
85 „	..	10	23
90 „	..	9·5	
100 „	..	10	23

In this case pilocarpine caused—

(1.) An approximation of the far point, which began at the 10th minute, reached its maximum at the 30th minute, and disappeared at the 85th minute. The maximum approximation was equivalent to 4·74 D.

(2.) An approximation of the near point, which began at the 15th minute, reached its maximum at the 20th minute, and disappeared at the 80th minute. The maximum approximation was equivalent to 1·11 D.

(3.) A contraction of the pupil, which began at the 15th minute, reached its maximum at the 20th, and was in that condition at the 105th minute, when the observations were discontinued.

(4.) A decrease in the range of accommodation, which was interrupted between the 85th and the 100th by an increase. The decrease reached its maximum at the 25th minute, and was then 3·82 D., that is 0·67 of the normal

range (5·65 D.), so that at this time the total range was 1·83 D. The maximum increase was ·53 D. (*See* Chart.)

Case XX.—W. L., æt. 32. *Left Eye.* Profuse Application. The Action of Eserine on this Eye is already recorded (p. 138.)

Time.	Pupil.	Near point.	Far point.
Before application..	3 mm.	9·5 cm.	20 cm.
After application—			
5 minutes	3	..	
10 „	3	8·5	17
15 „	2·5	8·5	13
20 „	2·5	9	13
25 „	2·5	8·5	13
30 „	2·5	8	13
35 „	2·5	8·5	13
40 „	2·5	8·5	14
45 „	2·5	8·5	17
50 „	2·5	8·5	17
55 „	2·5	9	17
60 „	2·5	9·5	22

In this eye pilocarpine caused—

(1.) An approximation of the far point, which began at the 10th minute, reached its maximum at the 15th minute, and disappeared at the 60th minute. The maximum approximation was equivalent to 2·69 D.

(2.) An approximation of the near point, which began at the 10th minute, reached its maximum at the 30th minute, and disappeared at the 60th minute. The maximum approximation was equivalent to 1·97 D.

(3.) A contraction of the pupil, which began within 15 minutes and reached its maximum at the 15th minute; it remained in this condition at the 60th minute, when the observations were discontinued.

(4.) A decrease in the range of accommodation, interrupted by an increase between the 5th and 10th and between the 45th and 50th minutes. The decrease reached its maximum at the 20th minute, and was 2·11 D., that is,

0·38 of the normal range (5·53 D.), so that at this time the total range was 3·42 D. The increase reached its maximum at the 10th, 45th, and 50th minutes, and was then 0·35 D., so that at those times the total range was 5·88 D.

Case XXI.—Action of Pilocarpine on Presbyopes. A. R., æt. 51.

Left Eye. V. $= \frac{6}{6}$. Hm. 0·5 D. In the Right Eye, which possessed the same Refractive Character as the Left, Eserine produced a Great Increase in the Range of Accommodation as already recorded (p. 166).

Time.	Pupil.	Near point.	Far point.
Before application..	5 mm.	63 cm.	−200 cm.
After application—			
5 minutes	5	63	−200
10 ,, ...	4	40	
15 ,, ...	3	30	175
20 ,, ...	3	30	125
25 ,, ...	2·5	25	200
30 ,, ...	2·5	30	Much receded.
35 ,, ...	2·5	30	
40 ,, ...	2·5	28	
45 ,, ...	2·5	26	
50 ,, ...	2·5	32	Distant vision
55 ,, ...	2·5	34	not quite so
60 ,, ...	2·5	33	good as before
65 ,, ...	2·5	30	application.
70 ,, ...	2·5	30	
75 ,, ...	2·5	30	
80 ,, ...	2·5	33	
85 ,, ...	2·5	33	
90 ,, ...	2·5	33	
95 ,, ...	2·5	30	
120 ,, ...	2·5	35	
130 ,, ...	2·5	35	

In this case pilocarpine caused—

(1.) An approximation of the far point, which began at the 15th minute, reached its maximum at the 20th minute, and disappeared at the 50th minute. The maximum approximation was equivalent to 1·3 D.

(2.) An approximation of the near point, which began at the 10th minute, reached its maximum at the 25th

minute, and existed to some extent at the 130th minute, when the observations were discontinued. The maximum approximation was equivalent to 2·41 D.

(3.) A contraction of the pupil, which began at the 10th, reached its maximum at the 25th minute, and remained in this condition at the 130th minute.

(4.) An increase in the range of accommodation, which began at the 5th minute, reached its maximum at the 45th minute, and still existed to a considerable degree at the 130th minute. The increase at its maximum was 2·26 D., that is, 1·08 of the normal range (2·09 D.), so that at that time the total range was 4·35 D.

Summary.

A profuse application of a 1 per cent. solution of pilocarpine to these healthy emmetropic and ametropic eyes caused—

(1.) An approximation of the far point, which began from the 10th to the 25th minute, reached its maximum from the 15th to the 35th minute, and disappeared from the 50th to the 85th minute. The maximum approximation was equivalent to from 2·22 D. to 4·74 D.

(2.) An approximation of the near point, which began from the 10th to the 20th minute, reached its maximum from the 20th to the 35th minute, and disappeared in from 60 to 80 minutes and later. The maximum approximation was equivalent to from 1·11 D. to 7·06 D.

(3.) A contraction of the pupil, which began from the 10th to the 15th minute, and reached its maximum from the 15th to the 30th minute.

(4.) An increase of the range of accommodation, which began from the 10th to the 15th minute, reached its maximum from the 10th to the 90th minute, and amounted to from 0·35 D. to 7·07 D. In two cases this increase was preceded by a decrease, which reached its maximum at the 20th and 25th minutes, and amounted to 2·11 D. and 3·82 D. The normal range varied from 2·09 D. to 12·11 D.

Taking the average of these results, it is seen that pilocarpine caused—

(1.) An approximation of the far point, which began at the 15th minute, reached its maximum at the 26·67 minute, and disappeared in 60·83 minutes. The maximum approximation was equivalent to 2·7 D.

(2.) An approximation of the near point, which began in 13·33 minutes, reached its maximum in 28·33 minutes, and returned in 70 minutes. The maximum approximation was equivalent to 3·51 D.

(3.) A contraction of the pupil, which began at the 13·75 minute, and reached its maximum at the 22·5 minute, and disappeared within 48 hours.

(4.) An increase in the range of accommodation, which began in 11·25 minutes, and reached its maximum in 60·9 minutes. The maximum increase was equivalent to 2·72 D., whilst the average normal range was 7·84 D., that is, the proportion of the increase to the normal range was 0·36 D.

The decrease of the range which occurred in two cases was at its maximum at the 22·5 minute, and was then equivalent to 2·96 D.

Tweedy (12) seems to have been the first to draw attention to the influence of extract of jaborandi on the eye; he states that after its local application there occurred "tension of the accommodative apparatus of the eye with approximation of the far and near points of distinct vision." In his case the maximum effect was noticed in 40 minutes, and the effect had quite passed away in 90 minutes, but he does not refer to the influence on the range of accommodation, nor is it possible to estimate it accurately from his figures.

George (13) applied a 10 per cent. glycerine extract to his eyes, and found that the far and near points were approximated, and that the maximum approximation of the near point was reached in from one-half to five-fourths of an hour, but apparently he never observed the change in the range.

A. Weber (22) does not refer to its action on the accommodation apparatus.

Fronmüller (23) states that the action of jaborandi and pilocarpine is identical.

Königshofer (33) applied extract of jaborandi locally, and could observe no action on the pupil or accommodation, but local application of pilocarpine caused "einer Anspannung, die sich nach und nach steigert, um nach ¾ Stunden einen Grad zu erreichen, zu dessen Ausgleichung ungefähr ein Convexglas von 40 Zoll Brennweite erforderlich war. Gleichzeitig rückt der Nahepunkt um ca. 1″ herein. Hand in Hand mit dieser Hereinrückung der Fern- und Nahepunkte geht eine hochgradige Verengung der Pupille." . . . "Die Accommodationsanspannung gleicht sich nach 1¼ bis 1½ Stunde wieder vollkommen aus." The myosis, however, lasted about one day.

Scotti (28) says that the far point was not very much approximated by pilocarpine, but neither he nor Königshofer draws attention to any alteration in the range of accommodation which it produces.

Just (35) simply says "und einen starken Reiz für die Accommodation darstellt."

Doyer (36) also does not refer to any alteration of range.

Albertoni (34) applied to the eyes a few drops of a 1 or 2 per cent. solution of pilocarpine, and found "während der ganzen Dauer der Myose wird das Auge in der That myopisch; der Nahpunkt ist ungefähr um die Hälfte näher ans Auge herangerückt (von 14 auf 7, von 16 auf 8 cm.), der Fernpunkt ist ebenfalls sehr stark genähert und fällt beinahe mit dem Nahpunkt zusammen, so dass um die ursprüngliche Sehweite wieder herzustellen starke Negativlinsen erforderlich sind. Ja die Annäherung des Fernpunktes übertrifft immer an Dauer und Intensität diejenige des Nahpunktes. Hat die Myose aufgehört, so ist der Accommodationskrampf durchaus noch nicht verschwunden, sondern blos schwächer geworden, denn der

Fernpunkt ist noch immer sehr stark genähert. Indem der Accommodationskrampf sich nach und nach abschwächt, hört er erst ungefähr 4—5 Stunden nach der Einträufelung gänzlich auf, nämlich 2—3 Stunden nach Beginn der Mydriase." Nitrate and hydrochlorate of pilocarpine act in much the same manner. From this it would seem that he caused a decrease of the range by local application, and that the far point did not recede to its normal position for several hours.

Lewin (38) says that by subcutaneous injections the eye was made myopic, and whilst the far point was much approximated the near point was more powerfully affected. Local applications caused much the same thing.

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Chart of Case 1.

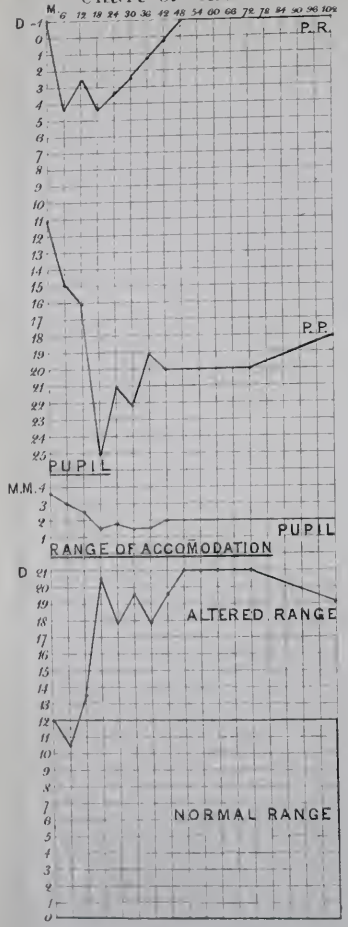
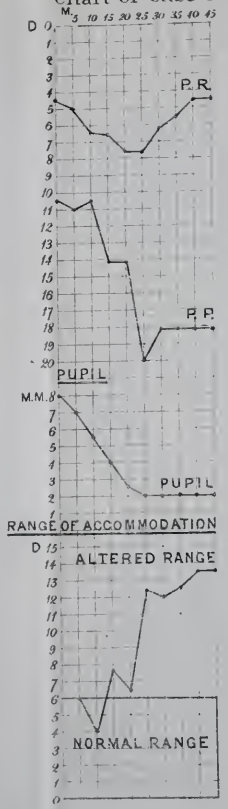


Chart of Case 4.



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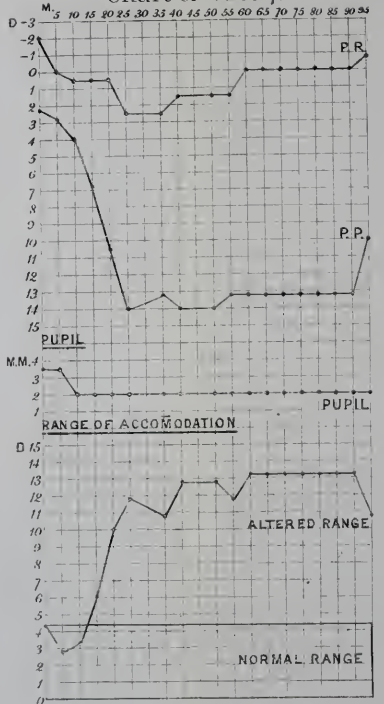

Chart of Case 14.

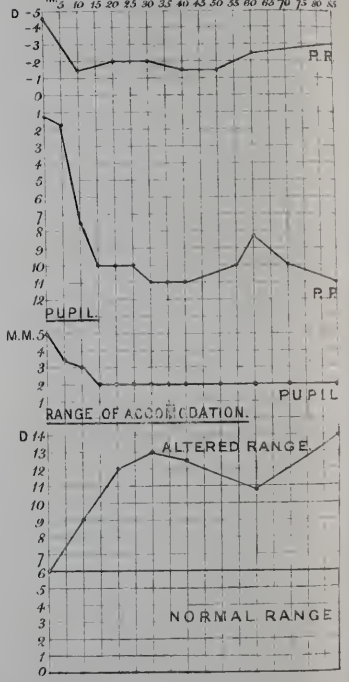

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Chart of Case 16.

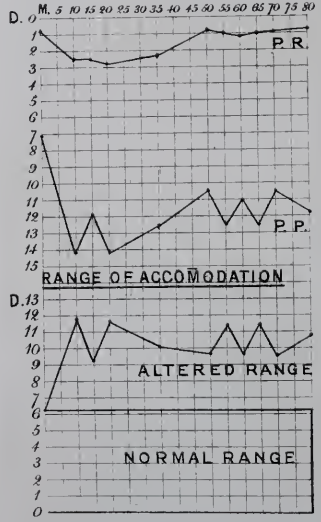


Chart of Case 17.

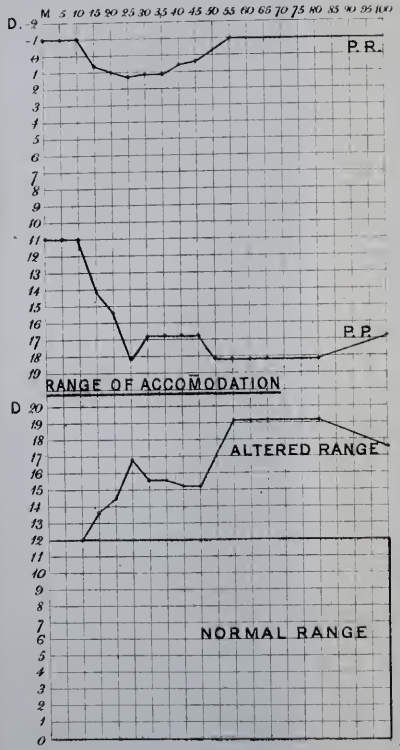
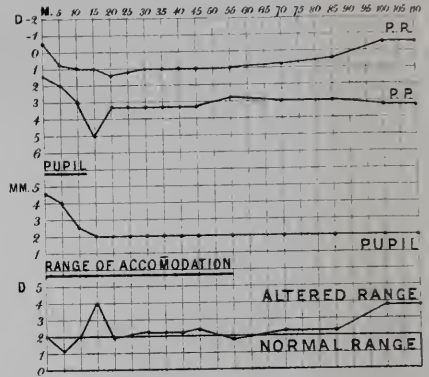


Chart of Case 12.



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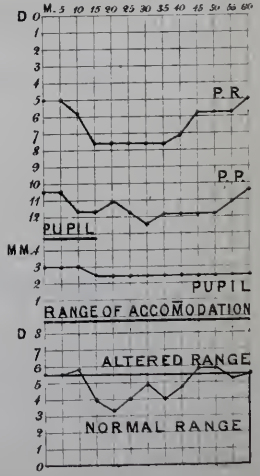

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ON A CASE OF UNSYMMETRICAL TOBACCO-AMAUROSIS.

By J. Hutchinson, Jun., F.R.C.S.,

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The exact symmetry of this affection is one of its most marked features, at any rate in the great majority of cases. The patients state that "the sight failed in both at the same time," and on testing their near and distant vision one finds the same amount of defect in each eye. However, in Mr. Nettleship's 23 cases (St. Thomas's Hospital Reports, 1879), and amongst those given in Mr. Hutchinson's paper (Ophth. Hosp. Reports, 1876), there are a few exceptions to exact symmetry, *e.g.*, 16 J. and 12 J. in the two eyes respectively, exceptions which may sometimes be accounted for by an original difference in visual acuteness, &c. In fact, the former author states that "the scotoma of tobacco amblyopia is invariably symmetrical." Hence the present case seems worthy of publication, since the notes were fortunately precise enough from his first attendance, and especially since the uniocular nature of the disease for some six months led at first to a mistaken diagnosis and treatment.

George W., æt. 42, a strong-looking waterman, came first in April, 1884, to Moorfields, for his right eye.

Right, V = $\frac{20}{70}$ and 10 J. *Left*, V = $\frac{20}{20}$ and 1 J. Retinitis was suspected, and he was ordered 5 grs. of iodide of potassium thrice daily, and to use atropine drops.

He attended regularly for a considerable time at first, but, the sight not improving, he neglected coming until the other eye had also failed.* This occurred first at the end of September, 1884, more than six months after the onset in the *right* eye. The two soon became equally defective, and on January 15, 1885, V = R. $\frac{20}{100}$, 19 J. at 7″; L. $\frac{20}{200}$, 16 J. at 7″. The fundi were normal, the fields for white good, but there was a scotoma for

* It should be mentioned that he was continuing his habit of smoking—about ½ oz. of shag daily.

red and green extending from the fixation-point to beyond the blind spot, and about 15° upwards and downwards; inside this area he called the red yellow, and the green white, outside it he recognised them well. There was no scotoma for blue. He had mistaken silver and gold on several occasions, and saw better in the evening than in bright daylight. Knee reflexes normal, pulse from 70 to 80, very compressible, but not intermittent. Had been lately liable to palpitation of the heart if he exerted himself; very nervous since the sight failed, but this was no doubt to be accounted for by his consequent loss of work, and the fact that he had nine children dependent on him. There was neither albumen nor sugar in the urine.

Ordered: Tinct. ferri perchlor.

Tinct. nucis vomicæ *aa* ℿx t. d. s., and forbidden tobacco.

As the right eye had failed first, so it was the first to regain good vision.

Jan. 26. V = R. $\frac{20}{50}$; L. $\frac{20}{100}$. The constant current was tried to the left eye, but produced no improvement.

Feb. 19. R. 1 Jaeger badly; L. 10 Jaeger badly.

By the beginning of April, 1885, V was $\frac{20}{20}$ and 1 J. with either eye.

He has since smoked mild tobacco in moderation, and the vision has continued perfect. I saw him last in April, 1886. His only complaint then was of frequent diarrhœa, or rather partial incontinence of fæces; this had affected him for several years. Knowing that this symptom is met with in locomotor ataxia, I tested him in every way for corroborative signs, but none could be found, and there seems no doubt that the case was one of tobacco amaurosis alone.

Symptoms accompanying Tobacco Amaurosis.—It has often been noticed that these patients are "nervous," and it is well known that much smoking causes temporary tremor of the hands, &c. In several typical cases, however, of which I have notes, neither symptom was present, and the nervousness may often be attributed rather to the failure of sight than to any direct effect of the tobacco.

In the following case, however, the condition of the heart was probably due to the drug.

Edwin P., æt. 66, had smoked half an ounce of "shag" tobacco daily for twenty years. V in each $= \frac{5}{200}$, and 16 Jaeger (with glasses). Typical scotoma and other signs of tobacco-amaurosis. Media clear, fundi normal, pupils $2\frac{1}{2}$ mm. (dilate almost imperceptibly when the light is removed). Reflexes normal.

Digestion strong, but occasional slight diarrhœa. Great nervousness, especially during the last twelve months (his vision had only failed about two months, according to his statement). He drank very little alcohol, rarely two pints of ale in the day.

His pulse was irregular; thus in four nearly consecutive half-minutes it was 39, 46, 43, and 43. In addition to this it was distinctly intermittent at long intervals.

But, in most of the cases I have examined, the pulse showed nothing abnormal, and probably "the tobacco-heart" would be more often found in those commencing the habit than in those who have been for long addicted to it.

It would be interesting to know if the mild kinds of tobacco produce amaurosis, except as an extreme rarity, and hence whether they need be forbidden to those patients who find it almost impossible to give up the habit entirely. Certainly shag, cavendish, and other strong dark varieties of tobacco are the causes in the great majority of cases; one man, however, attended Moorfields with amaurosis from smoking 1 oz. of "May Blossom" per diem, and another from the constant use of Manilla cigars.

M. Fournier has drawn attention to the presence in inveterate smokers of white patches of mucous membrane just within the commissures of the lips, and he regards them as an almost infallible test. In a good number of cases of tobacco-amaurosis, the typical patches (triangular with the apex backwards when the mouth is opened wide) are to be found, but in several I have failed to find any trace of them. Probably they depend solely on the scorching action of the hot smoke, and hence will vary with the kind of pipe used.

Drawings of Cases described
by Mr J. Hutchinson. Junr.

Fig 1. Development of New Vessels on Papilla

Fig 2 Peripheral Choroido-Retinitis

J. Hutchinson Jun. del

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RELAPSING OPTIC NEURITIS, WITH DEVELOPMENT OF NEW VESSELS IN FRONT OF THE PAPILLA.

By J. Hutchinson, Jun.

As will be seen from the notes, there was strong reason for regarding both the following cases of lymph and formation of new vessels in front of the optic disc as being due to syphilis. There seems no reason why such a condition should not be met with in as large a proportion of cases as is the vascular deposit on the iris in inflammation of that structure. But little attention, however, seems to have been drawn to it, and the following examples are on that account worthy of record :—

Case I.—Thomas R., a fine healthy-looking soldier, æt. 28, first noticed gradual painless failure of sight about September, 1884. It was not, however, until June 4, 1885, that he attended Moorfields, having meanwhile received little, if any, treatment. His vision then was in the right eye $\frac{20}{200}$ and 19 Jaeger, and in the left $\frac{20}{200}$ and 16 Jaeger. In both there were very evident remains of optic neuritis, and in front of the right optic disc (covering a considerable part of its outer half) was a patch of small new vessels surrounded by lymph and projecting into the vitreous. His refraction was normal, and the summit of the patch was best seen with about + 6 D. In the left eye the condition was much less marked, and ultimately disappeared. At first it appeared as though there were several small vessels, but when under treatment the lymph had disappeared it was obvious that one small branch came off from the arteria centralis and coiled itself up in a corkscrew manner. There were no other opacities in the vitreous, and the patient was quite conscious of the existence of the one described, comparing it to the "tendrils of a vine," a very apt simile.

He admitted having had venereal disease (chancres and gonorrhœa), but the history of secondary syphilis was defective.

He was ordered Hydrarg. cum Cretâ, gr. i; Pulv. Doveri, gr. ss., bis die; and Potassii Iod., gr. v.; Sp. Amm. Arom., ʒ ss., ter die. For a month or two he attended irregularly (owing to his station being at Aldershot), and his vision fluctuated. In September he was compelled to retire from the army, and after this underwent regular specific treatment.

On November 16. V = $\frac{20}{70}$, R. 6 Jaeger; L. 8 Jaeger. New vessels less distinct.

November 26. V = $\frac{20}{50}$, 1 Jaeger and 4 Jaeger.

He now took only Hydrarg. cum Cretâ, gr. i, bis die.

In January, the right eye having meanwhile steadily improved, he had a relapse of optic neuritis in the left, with great impairment of vision, now barely $\frac{20}{200}$.

Iodide of potassium and mercury were then given together, and on March 1 he read 1 Jaeger and $\frac{20}{40}$ well with either eye. All lymph had disappeared from the vitreous in the right eye, and only a beautifully coiled single vessel remained, and when last seen (July, 1886) it had not changed in appearance.

At this date he had another relapse of neuritis in the left eye, with again great impairment of vision, the attack quickly yielding to specific treatment. It is possible that the new vessel in his right eye will ultimately, as in Von Jaeger's case (quoted later), entirely disappear, or, what is perhaps more likely, will remain as a white band, liable to be mistaken for the remains of a persistent hyaloid.

It is to be noted that the patient had probably had optic neuritis several months before he was first treated. He was a temperate man, and his general health remained good during the time he attended Moorfields, nor did any syphilitic symptoms appear.

The following case was lately under my father's care, and the accompanying notes were made by him:—

Case II.—Mr. R., æt. 33, had syphilis early in 1884, and about February of the next year the right eye began steadily to fail. He underwent no specific treatment, and it was only some

seven months later, when the left eye had also become very defective, that he took alarm.

On October 10, 1885, a drawing was made of each eye, and the condition was as follows. The disc-margins (particularly the outer margin of the right) were blurred, and the papillæ were swollen, and, in addition to the optic neuritis, there was a crescentic patch of vascular lymph placed nearly vertically over part of the disc (towards the outer side) in each eye.

He complained of aching pain in the left temple and eye. The visual field was so narrowed that when walking about a room he appeared almost blind. His pupils were small and almost motionless. He noticed a sort of flame before each eye. He was the subject of pulmonary phthisis and had lately lost flesh rapidly. On this account the case could not be followed up, but during the few weeks that he underwent specific treatment but little change in the ocular condition was observed. The development of minute new vessels was as great as in the first case, and, it is interesting to note, occurred at the same part of the disc, only the changes were exactly symmetrical.

It may be said that these cases belong to the same group as that described by Messrs. Charnley and Fox in a previous number of these Reports, but I do not think this is quite correct. There was no reason to suspect syphilis in the cases adduced by these writers, repeated attacks of optic neuritis did not occur, and the coiling new vessels were seen, not in front of the disc, but at some distance from it. One would not, however, lay much stress on the latter point, and the case described and figured in Ed. Jaeger's "Beiträge zur Pathologie des Auges" (Vienna, 1870) seems to furnish a connecting link. The illustration (Plate XXXII.) shows signs of previous optic neuritis with extensive development of new vessels in the vitreous, starting from the arteries in the papilla, some of them being looped and others forming coils.

The patient was a tailor's apprentice of unhealthy aspect, who at the age of 25 was seized with headache and great visual

defect, so that for a time he was obliged to give up work. His sight improved slowly, and seven months later he had a return of the same symptoms. After this relapse he noticed that there was something moving in the right eye, which he compared to a spider. He was again able to return to work, but eight months later a third attack (this time without headache) occurred. He could now only see 20 J., and came under Von Jaeger's observation and treatment. There was no evidence of renal or other visceral disease, but unfortunately no mention is made as to a history of syphilis. The visual field of the right eye (in which there were neuritis, retinitis, and vitreous opacities, but no new vessels) was considerably limited, that of the left (in which the new vessels were freely developed, but the other changes less marked) was normal. Mercurial inunction was instituted. For a short time little improvement took place, and the capillary coils (as in Case I.) became more sharply defined, no doubt owing to the surrounding lymph being absorbed; but after four months' treatment "all traces of the new vessels had disappeared," the neuritis, &c., had greatly improved, and vision = 5 J.

This case offers a very close parallel to my first one, not least in the repeated relapses of neuritis, a rather uncommon occurrence. Dr. Gowers ("Med. Ophthalmoscopy," p. 49) observes, "When atrophy is partial or absent, in rare cases two attacks of neuritis may occur." In two of the three cases given above at least three attacks occurred, at intervals of a few months. All were in men of early adult age. That the development of new vessels would be seen more often, did patients neglect all treatment when attacked by syphilitic neuritis, may, I think, safely be assumed.

In Galezowski's "Traité Iconographique" (Plate XVIII.) there is a representation of a number of small spiral vessels in front of one disc as well as in the y. s. region. The case was that of a young man, aged 23, who contracted syphilis at the age of 19. Galezowski terms them arterio-venous communications due to endarteritis obliterans of some branches only of the retinal artery, the others remaining

of good size. No changes in the walls of the main arteries in any of the previous cases could be detected. No note as to the result of treatment or the progress of the case is given by M. Galezowski.

I am indebted to Mr. Waren Tay's kindness for permission to publish the first of these cases.

CURATOR'S PATHOLOGICAL REPORT.

By J. B. Lawford, M.D., F.R.C.S.

Part I.—*Eyes containing Foreign Bodies at Time of Excision.*

The following tables contain brief notes of 27 eyeballs, which were found, on examination after removal, to contain foreign bodies, and include all such excised in the hospital between November, 1884, and January, 1886.

A review of the tables will disclose the following figures. Of the 27 patients 26 were males. In 9 the *right* eye was wounded, in 18 the *left;* 21 patients received the injury while actually at work at their calling, and of this number in 6 the right and in 15 the left eye was the seat of the injury.

The wound of entrance was in the cornea in 15; in the sclerotic in 8; involved both tunics at their junction in 3; and in one specimen (No. 18) the site of wound was not discovered, but was probably in the sclerotic.

Suppurative inflammation occurred in 15 of the wounded eyeballs; of the remaining 12, Nos. 7 and 20 were excised too soon after injury for such processes to have become evident even if beginning.

Of the 15 in which the cornea was the seat of the wound of entrance, prolapse of iris into the wound occurred in 5; and in one other (No. 5) an iridectomy had been done elsewhere soon after the accident, and probably a prolapsed portion of iris removed.

In one case only (No. 23) had the eye been defective before the injury.

The longest interval between the accident and excision was 6 years (No. 2). It is certainly noteworthy that in no case was sympathetic inflammation set up; and in only one (No. 15) did symptoms of "sympathetic irritation" arise after the foreign body had been in the injured eye for 8 weeks.

Microscopic examination was made in 15 of the 27 eyeballs.

The following cases (Nos. 5, 11, 14, 22) may be described more in detail than can be done in the tables :—

No. 5.—Patient had an "iridectomy and removal of lens" performed at another hospital, very soon after the accident, in July, 1884. In August, 1884, he was admitted at Moorfields, and discharged after 3 weeks' stay, the eye having become quiet. On May 1, 1885, he returned with inflammatory symptoms, and the eye was removed. There was no injury other than that in July, 1884, and nothing to account for the relighting of the inflammatory processes. On microscopic examination it was evident that the changes found had occurred at different dates. The corneal scars were well healed, and from each a firm band of organised tissue, consisting of long well-formed cells, with fusiform nuclei, extended backwards through the pupil into the vitreous. With this the pupillary edge of the iris was incorporated. The suppurating vitreous about the foreign body, on the contrary, showed nothing but leucocytes in large numbers, and the changes here were evidently of recent origin.

No. 11.—In this specimen the detached retina showed very advanced pigmentary degeneration. The normal layers were not distinguishable as such, the nerve elements especially being scarcely anywhere recognisable. The Müllerian fibres were unusually prominent. Scattered abundantly through the retina were small masses of black pigment, bearing no constant relation to the remnants of any of its layers or to the blood-vessels. The pigment was apparently in cells resembling those of the granule layers. There were signs of old, but none of active inflammation in any of the tissues, and at the time of excision there was no blood-clot in the eye. There was good evidence that the eye was not defective before the accident.

No. 14.—In this specimen the chip of steel (which flew from a "steel drift" patient was chiselling) entered

through the sclera, near the outer corneal margin. It was seen by ophthalmoscopic examination, and was found after excision in the upper and outer part of the vitreous 3 mm. (roughly) from the ora serrata. But close to the upper and outer edge of the disc there was a small blood-clot in the retina and choroid beneath; and it is not unlikely that the chip traversed the vitreous, struck and wounded the retina and choroid at the posterior pole, and fell back into the vitreous, where it was found. There were no other retinal or choroidal hæmorrhages.

Nos. 17, 19, *and* 20 are remarkable chiefly for the large size of the foreign bodies embedded in the eyeball, and allowed to remain there (in 2 of the 3 cases) for two and ten weeks respectively.

No. 22.—In this specimen the chip of steel lodged in the retina and choroid near the O.D. The retina at that point was greatly disorganised by the hæmorrhage which occurred, and the choroid showed well-marked inflammation. One of the short ciliary arteries pierces the sclerotic exactly at this point, and has become involved in the inflammatory process, which could be well seen travelling along this vessel through the sclerotic. This coat is considerably thickened here and infiltrated with indifferent cells. In its course through the vitreous the chip had cut the retina and choroid, and scored the inner surface of the sclerotic for a length of 15 mm. in the area corresponding to the space (externally) between the superior and external rectus.

Sex, age. Date of excision. Surgeon. Registered No.	Nature of accident.	Time between accident and excision.	Condition of injured and other eye since accident and at date of removal.	Changes in excised eye. Site of foreign body.
(1) M., æt. 48. 24/10/84. Mr. Lawson. 1604.	Wound of L. by chip of stone while stone-breaking.	14 days.....	L. 3 days after accident some lens matter removed. Subsequently iritis and + T. V. = p.l. R. No symptoms.	Two small central wounds of cornea, not healed: swelling of cornea around them. Adhesion of pupillary border of iris to cornea at site of wound: posterior synechiæ: opaque remains of lens: vitreous detached posteriorly, and contains blood clot: choroid and retina show no changes. The foreign body has traversed the lens, and is lodged in vitreous close behind lens on temporal side.
(2) F., æt. 17. 1/11/84. Mr. Gunn. 1613.	L. Injured by bursting of a percussion cap.	6 years.....	L. Fragment of metal in lower part of A.C. Iris tremulous; lens opaque. V. = bare p.l. T.n. R. No symptoms.	Chip of metal (2 mm. × 1 mm.) loose in A.C. Small scar in cornea near lower and inner margin: in lower ⅓ of A.C. is a dense mass firmly adherent to iris and cornea: it consists of long well developed cells with fusiform nuclei, and contains blood-vessels. Iris at lower part considerably disorganised: lens shrunken and opaque: capsule wrinkled: no wound of capsule found: ciliary body atrophied. Vitreous fluid, retina and choroid little, if at all, altered.
(3) M., æt. 17. 20/11/84. Mr. Tay. 1629.	L. Injured by bursting of a percussion cap.	5 weeks	Admitted 3 days after accident. L. Central wound of cornea. Opaque lens; posterior synechiæ. Lens matter evacuated 3 weeks later. R. No symptoms.	Wound of cornea healed, but adherent to its posterior end is a band of lymph and some lens capsule; the iris adheres to this band. Ragged piece of gun-cap lying on ciliary processes at temporal side and in upper half of eye; it is encapsuled by tough lymph. Slight, but definite, inflammation of retina and choroid. O.D. not swollen, but vessels show undoubted inflammatory changes, which are evident also in anterior part of O.N.

Sex, age. Date of excision. Surgeon. Registered No.	Nature of accident.	Time between accident and excision.	Condition of injured and other eye since accident and at date of removal.	Changes in excised eye. Site of foreign body.
(4) M., æt. 27. 3/12/84. Mr. Nettleship. 1638.	L. Injured while chipping brass.	5 days	Admitted 5 days after accident. L. Lens opaque and bulging through vertical rent in capsule. T. — 1. Central scar in cornea; lens matter evacuated; vitreous followed; eye excised.	In lower part of vitreous is a chip of brass, size of hemp-seed; it is not in contact with retina. Vitreous immediately surrounding it is denser than normal and slightly infiltrated. No other changes.
(5) M., æt. 22. 5/1/85. Mr. Tay. 1671.	R. Injured by bursting of a percussion cap.	5½ months...	R. Soon after accident an iridectomy and removal of lens matter was performed at another hospital. At date of excision, central corneal scar; coloboma of iris downwards and outwards; opaque capsule in pupil; T.n. L. No symptoms.	Chip of gun-cap lying in vitreous against retina on nasal side of globe. Commencing suppuration in surrounding vitreous. Inflammation of iris. From scars in cornea (that of wound and that of iridectomy) two bands of organised lymph stretch backwards into vitreous; to them iris and lens capsule adhere. Some degenerated lens matter still enclosed in capsule. Choroid and retina, except in immediate vicinity of foreign body, show no inflammatory changes.
(6) M., æt. 20. 3/12/84. Mr. Lawson. 1639.	L. Injured by a piece of a nail.	4 days	L. Cornea hazy. Small wound in ciliary region. Lens clear. Fundus reflex dull.	Chip of metal, size of a hemp-seed, lying on retina close behind ora serrata on temporal side of globe: about it there is some blood clot. The wound of entrance is immediately below insertion of internal rectus, and the track of foreign body traverses ciliary body, from which there has been some bleeding into vitreous. Lens intact; no inflammatory signs.

(7) M., æt. 25. 14/2/85. Mr. Nettleship. 1714.	L. Injured by chip from a metal rivet.	9 hours	L. Large ragged wound of cornea, with prolapse of iris.	Chip in vitreous; cornea becoming hazy near wound; foreign body had traversed lens.
(8) M., æt. 21. 18/2/85. Mr. Gunn. 1719.	L. Struck by a chip of steel.	8 days	L. Wound just beyond inner edge of cornea. Hypopyon. Iritis. Central and posterior polar opacity of lens. T. − 1. R. No symptoms.	A sharp triangular chip of steel in vitreous at equator below, in contact with retina; wound of entrance is through ciliary body on inner side, just anterior to ora serrata. Commencing suppuration of vitreous around foreign body. Iritis and cyclitis. Lymph lining anterior surface of iris; well marked but slight inflammation of O.D. and retina; lens not wounded; no evident opacity after enucleation.
(9) M., æt. 19. 1/4/85. Mr. Gunn. 1758.	L. Wounded while chipping brass.	5 days	L. Linear wound of cornea, towards inner side. Prolapse of iris. Cornea and aqueous yellow and semi-opaque. T.n. ? + ; V. = hand-reflex. R. No symptoms.	Chip of brass had traversed cornea, iris, and lens, and lodged at lower part against retina close behind ora serrata. Suppuration in vitreous around foreign body. Foci of suppuration in retina posteriorly. Choroid inflamed. Lens opaque in lower and inner part, where pierced by foreign body. Lymph on iris and anterior lens capsule.
(10) M., æt. 29. 2/4/85. Mr. Lang, 1761.	L. Struck by chip of steel.	21 days.....	L. Purulent iritis, hypopyon. P. filled with lymph. T.n. R. No symptoms.	A small central scar in cornea, well healed and not infiltrated. Another small scar just beyond corneal margin down-in. Lens opaque and shrinking, has evidently been wounded. Iritis, cyclitis. Swelling of O.D. Fragment of steel lying on pars ciliaris retinæ below; surrounded by suppurating vitreous. From this point paths of suppuration stretch backwards through vitreous.

Sex, age. Date of excision. Surgeon. Registered No.	Nature of accident.	Time between accident and excision.	Condition of injured and other eye since accident, and at date of removal.	Changes in excised eye. Site of foreign body.
(11) M., æt. 19. 15/4/85. Mr. Gunn. 1772.	R. Injury by a chip of steel.	About 6 months.	Admitted about 3 months after accident. R. Corneal nebula; posterior synechia. Extensive shallow detachment of retina. A lustrous body seen by ophthalmoscope near lower ciliary region. Vitreous full of dust opacities. V. = fingers at 6″. T. − 1. L. No symptoms.	A fragment of steel, size of pin's head, lying on inner surface of retina at lower part, 2 mm. behind ora serrata. Vitreous shrunken and detached. Extensive shallow detachment and pigmentary degeneration of retina. Lens not wounded. Iris and ciliary processes atrophic. No inflammation now evident. Corneal wound well healed; it is near outer margin.
(12) M., æt. 44. 27/4/85. Mr. Tay. 1787.	L. Wounded while "rivetting."	20 days.....	Admitted 9 days after accident. L. Hypopyon. Iritis. Lens opaque. T. "full." Intense ciliary congestion. R. No symptoms.	Scar in cornea at upper and outer part; the foreign body (a chip of steel) entered here, traversed the lens obliquely and lodged against retina at lower and inner part, just behind equator. Inflammation of iris and ciliary body. A small amount of hæmorrhage in vitreous, but no suppuration. At site of foreign body retina and choroid inflamed and closely adherent, the former much disorganised. Slight swelling of O.D.
(13) M., æt. 29. 2/5/85. Mr. Gunn. 1795.	R. Struck by chip of copper.	8 days.....	Admitted day after accident. R. Wound in sclera up and in. V. = p.l. T. − 3. Opacity in vitreous. Subsequently fundus reflex lost. Yellow	Wound in sclera on inner side, 4 mm. from corneal margin. Sclera thick and inflamed at cut edges. Wound filled by inflammatory products, to which the choroid (also inflamed) is adherent. Some blood on inner surface of choroid. Chip lies in vitreous on

			streaks seen in vitreous by focal light. T.n. at time of excision.	outer side, anterior to equator, and vitreous around it is suppurating. Commencing inflammation of retina and slight swelling of optic disc.
(14) M., æt. 17. 5/5/85. Mr. Lawson. 1797.	R. Struck by chip from a "steel drift."	3 days.....	R. Wound in ciliary region down and in. Chemosis. No reflex from lower part of fundus; but at upper and outer part a brilliant point is visible in a dark circular area. T.– 1. V.$=\frac{20}{50}$.	Cornea, iris, and lens healthy. Wound of entrance in sclerotic 3 mm. from inner margin of cornea; foreign body lodged in vitreous at upper outer part near ora serrata. Some hæmorrhage in vitreous. 3 mm. from temporal edge of disc there is a small blood clot in retina and choroid.
(15) M., æt. 45. 8/5/85. Mr. Lang. 1799.	R. Struck by chip from a metal bolt.	8 weeks.....	Not seen till 8 weeks after accident. R. Scar in ciliary region above; p. drawn up. Lens clear. No reflex from fundus. V. = p.l. T.n. L. "Misty" for 2 days. V.$=\frac{6}{6}$ Hm. 0·75 D.; +1·75 D. = 1 J. No signs of disease.	Chip of metal, 6 × 4·5 mm., embedded in retina and choroid on outer side, just behind equator; surrounded and firmly held in position by lymph. It had traversed ciliary body above, missing the lens. The wound is filled up by abundantly nucleated tissue, in which curled ends of cut sclerotic fibres are seen. The ciliary muscle fibres are much degenerated at this part. The vitreous is detached posteriorly except at papilla. It contains some old blood clot. Retina shows definite inflammatory changes, especially in region of disc, which is slightly swollen. Choroid inflamed; the inflammation spreading from wound and from site of foreign body.
(16) M., æt. —. 1/6/85. Mr. Streatfeild. 1819.	R. Struck by chip of steel.	2 days	R. Infiltrated vertical wound of cornea. A.C. filled with blood. No p.l. T. – 2.	Wound at inner part of cornea extending into ciliary region above. Lens gone. Vitreous suppurating. Large chip of steel in anterior part of vitreous, close to ora serrata. Retina *in situ;* not wounded.

Sex, age. Date of excision Surgeon. Registered No.	Nature of accident.	Time between accident and excision.	Condition of injured and other eye since accident and at date of removal.	Changes in excised eye. Site of foreign body.
(17) M., æt. 14. 17/7/85. Mr. Couper. 1871.	R. Struck by fragment of "hot steel."	2 weeks.....	Admitted 14 days after accident. R. wound of cornea in inner half, with yellow infiltration. Chemosis. No p.l. L. No symptoms.	Yellow infiltration of entire cornea; triangular wound at inner margin extending into sclerotic. A chip of steel measuring 2·4 × 9 mm. lies obliquely in eyeball, one end protruding through sclera close to outer side of O.N.; the other end bulges sclerotic in ciliary region close to wound of entrance. Suppuration in globe. Structures unrecognizable.
(18) M., æt. 30. 1/8/85. Mr. Nettleship. 1883.	L. Injured while chiselling granite.	9 days	Admitted 7 days after accident. L. Haze of cornea; iritis, hypopyon. V. = hand-reflex. T.n. P. became dilated, and hypopyon disappeared under treatment. R. No symptoms.	Wound of entrance not found. Cornea very slightly infiltrated; one posterior synechia; lens *in situ* and clear. Vitreous is cloudy and increased in density; contains some blood clot. In its lower and anterior part is a chip of steel 4·5 mm. long, and the thickness of a cataract needle; around it vitreous slightly yellow. No naked eye changes in retina or choroid. O.D. not swollen.
(19) M., æt. 22. 28/8/85. Mr. Streatfeild. 1900.	L. Struck by chip from iron rivet.	10 weeks	Admitted 10 weeks after accident. L. Vertical scar right across cornea; at junction of upper and middle thirds a point of metal projects, and resists traction. Yellowness behind lower part of cornea, which is itself hazy. No p.l. R. Hm. 1 D.V. $= \frac{6}{6}$; 1 J. at 10 c.m.; p. active.	A flat curved chip of iron 15 mm. long obliquely embedded in eyeball, one end projecting through cornea, the other resting on sclerotic below, at equator, having pierced retina and choroid. Intense plastic iridocyclitis with abundant formation of lymph. Inflammation of choroid and retina. Swelling of O.D. Lens almost entirely gone. Cornea swollen and greatly infiltrated.

(20) M., æt. 24. 17/10/85. Mr. Hulke. 1938.	R. Struck by chip from a metal rivet.	1 day	R. Wound "half-an-inch long" in lower ciliary region. Considerable chemosis.	A roughly semicircular chip of steel, 24 × 12 mm., occupies interior of globe, and bulges the sclerotic posteriorly. Contents completely disorganised.
(21) M., æt. 42. 17/10/85. Mr. Nettleship. 1939.	L. Struck by chip from a metal rivet.	44 days.....	Admitted 6 weeks after accident. L. Wound in lower ciliary region. Haze of cornea. Coloboma iridis down-out (operation elsewhere soon after injury). Lens clear. Opacity behind it. V. = p.l. T. − 2. R. No symptoms. V. = $\frac{6}{6}$.	An irregular jagged piece of metal embedded in retina at lower inner part, surrounded and firmly fixed by a capsule of yellowish tough lymph. Plastic iridocyclitis. Lens capsule opaque close to site of wound. Inflammation of retina and choroid. Swelling of O.D. Vitreous thin, but contains some blood clot, and several bands of lymph stretch through it from the situation of foreign body.
(22) M., æt. 26. 29/12/85. Mr. Lawson. 1985.	L. Struck by a chip of steel.	12 days.....	Admitted 12 days after injury. L. Wound of cornea with entangled iris upwards and inwards. Lens opaque throughout. "No sight." R. No symptoms.	Chip of steel 10 mm. long embedded in retina close to upper edge of disc. It is hidden by blood clot. One large hæmorrhage in retina below and to outer side of O.D., and several smaller ones found on microscopic examination. Except in vicinity of foreign body and wound of cornea, there are scarcely any signs of inflammation.
(23) M., æt. 40. 7/1/86. Mr. Lang. 1992.	L. Struck by a piece of cast iron.	3 days	L. Cornea steamy. Wound with entangled iris at inner sclero-corneal junction. Hypopyon. Opaque lens. T.n. V. = hand-reflex.	A small irregular chip of iron in vitreous; its exact situation uncertain as it became displaced during section of eyeball. Commencing suppuration of vitreous. Retina inflamed, and shows numerous small hæmorrhages, chiefly in equatorial region. Iris and ciliary body inflamed and covered by a layer of lymph. Lens wounded, and has undergone partial absorption.

Sex, age. Date of excision. Surgeon. Registered No.	Nature of accident.	Time between accident and excision.	Condition of injured and other eye since accident and at date of removal.	Changes in exeised eye. Site of foreign body.
(24) M., æt. 25. 20/1/86. Mr. Tweedy. 1996.	L. Injured by chip of iron.	20 days.....	Admitted 19 days after accident. L. Suppurating cornea with prolapse of iris up and in. Much circumcorneal injection and swelling of conjunctiva. T.n. No sight. R. No symptoms.	Sclerotic much thickened below. A jagged chip of iron lies internally to this thickened part, just anterior to equator, embedded in suppurating vitreous, which is enclosed in retina detached everywhere except at this part. Well-marked inflammation of retina and choroid and iris. O.N. shows similar changes extending a short distance behind lamina cribrosa. Lens completely degenerated, but capsule unaltered.
(25) M., æt. 36. 25/1/86. Mr. Tweedy. 1997.	L. Struck by a chip of brass.	5 or 6 days ..	Admitted day after accident. L. Vertical slit in cornea. Aqueous turbid. Lens partially opaque; lens matter removed; foreign body thought to be in lens. Subsequently symptoms of suppuration.	Chip of brass in vitreous, close to lens capsule. Vitreous suppurating. Inflammation of cornea about wound. Iritis with effusion of lymph. Ciliary body inflamed. O.D. swollen, and retina inflamed. Choroid much less so, except most anterior part, close to chief seat of suppuration in vitreous.
(26) M., æt. 9. 26/1/86. Mr. Lawson. 1998.	R. Wounded by explosion of a percussion cap.	29 days.....	Admitted 4 weeks after accident. R. Small scar in ciliary region on inner side. Yellow reflex from fundus oculi in lower part. V. = 20 J. T.n. L. No symptoms.	Scar just beyond corneal margin; well healed. The foreign body has entered here, and traversed ciliary muscle; missed the lens, and become embedded in lymph in vitreous close to site of wound. This lymph is adherent to lens capsule and ciliary processes. Inflammation of iris and ciliary body, and of retina and choroid, anteriorly. O.D. swollen and inflamed. Choroid posteriorly very slightly affected.

(27) M., æt. 5. 30/1/86. Mr. Lawson. 2001.	R. Struck by splinter of firewood.	3 days	R. Wound of cornea towards inner side, with infiltration about it. Prolapse of iris. Hypopyon. T. — 3.	A small splinter of wood projecting backwards from iris into vitreous on inner side of pupil. Vitreous suppurating in neighbourhood of splinter, and a layer of lymph lines ciliary processes. Iris inflamed and rotten. Lens wounded; partially absorbed. Retina and choroid becoming infiltrated.

PART II.—*Three Cases of Cystic Degeneration of Retina.*

The three cases described below are of considerable interest pathologically. They are good examples of changes in the retina which occur but rarely in a degree at all approaching that found in these specimens. In the examination of 600 consecutive eyeballs in the Moorfields Museum I have met with only four examples.* The fourth of these was an eyeball the retina and choroid of which had undergone so much degeneration that a careful examination entirely failed to give any reliable information as to the changes which had occurred, though there appeared to be two cysts in connection with the detached retina. It has been therefore omitted in this description.

CASE I (Reg. No. 1489). Right eye of a female patient, æt. 19.

Patient never remembers to have seen with the right eye. Two years before admission this eye was "inflamed," and has been painful on and off since. Eight weeks before admission "cataract" appeared. No history of injury.

On admission, R.E.: cornea and anterior chamber normal. Lens opaque. No perception of light. T. n.

L.E.: V. $= \frac{6}{6}$. Fundus normal.

After excision the eyeball was first hardened in Müller's fluid, and then divided into lateral halves while frozen.

Naked Eye Examination.—Cornea and *iris* normal. No adhesion at periphery. Ciliary processes rather flattened. *Lens in situ*, slightly shrunken, opaque throughout. *Vitreous* somewhat increased in density. *Retina*, extensive though shallow detachment, separated from choroid everywhere except at the optic disc and in its ciliary part. Detachment deepest at outer and lower part. Sub-retinal space filled by coagulated effusion. On temporal side, below, just anterior to the equator, is a cyst

* I do not include in this number cases of slight cystic dilatations in the pars ciliaris retinæ, a condition not infrequently met with in diseased eyes.

in the detached retina, the size of a small green pea, and near the optic nerve entrance is a similar, but smaller, cyst. Neither cyst is in contact with the choroid at any point, though they project from the line of the retina *outwards* towards the choroid, and are surrounded by the sub-retinal effusion. Each cyst contains a small quantity of coagulated jelly-like material. The *choroid* and *sclerotic* show no changes.

Case II (Reg. No. 1731). Left eye of a male patient, æt. 40.

This eye had been struck by a cork from a soda-water bottle 14 years previously. Has been painful lately.

On admission, R.E., V. = 1 Jaeger, T. n. Some pigment on lens capsule.

L.E., slight congestion. Cornea clear. Anterior chamber shallow. Posterior synechiæ. Iris "bombé." Lens opaque and white. No perception of light. T. + 2.

The left eye was hardened in Müller's fluid, and then divided antero-posteriorly into lateral halves.

Naked Eye Examination.—Cornea normal in thickness and curvature. Anterior chamber encroached upon at its periphery by the adhesion of iris to cornea for a distance of 1·5 mm. This is more noticeable on the temporal side. The iris in nearly its whole extent is separated into two layers, an anterior and a posterior. The former projects forwards towards cornea, and gives rise to the "bombé" appearance noticed before excision. The latter is firmly adherent to the anterior lens capsule; the small cavity thus formed in the iris is occupied by coagulated jelly-like effusion.

Lens in situ, white and opaque throughout.

Retina detached from choroid everywhere as far anteriorly as the ora serrata. At this point it is folded forwards on itself and curves inwards close to the posterior lens capsule, then stretching backwards to the optic nerve in a rounded cord. Some shrunken remnants of vitreous are enclosed in the folds of the retina. The space between the retina and choroid contains some friable blood clot, partially decolorised.

In connection with the detached retina are three cysts, one of which is as large as a pea, and the other two about half that

size. One is situated on the upper side of the stalk of retina, just posterior to the equator of the eye. The other two are (one in front of the other) on the lower side of the stalk, and their posterior limit corresponds to the centre of the first-mentioned cyst. All three spring from the retina posterior to the ora serrata, and therefore are not in connection with the pars ciliaris retinæ. They project *outwards* towards the choroid, but are at no point in contact with it. Their walls are very thin, semi-translucent, and in parts are slightly calcareous and brittle. Their contents were sufficiently fluid to escape when the section was made.

The choroid lines the sclerotic, and neither tunic exhibits any changes.

Case III (Reg. No. 1860). Left eye of a man, æt. 55.

Fifteen years previously this eye had been struck by a stone. It has been blind since the accident, but caused no inconvenience till three weeks before admission, when it became very painful.

On admission, R.E., central nebula of cornea, otherwise normal. V. $= \frac{6}{36}$.

L.E., iritis with old synechiæ. Opaque lymph on lens. Hyphœma. No perception of light. T. n.

Left eye excised, hardened in Müller's fluid, frozen, and divided into lateral halves.

Naked Eye Examination.—Cornea thin; anterior chamber deep, but encroached upon at the angle by adhesion of iris to cornea. A small amount of blood clot on anterior surface of iris. At the pupillary edge of the *iris* there are many points of adhesion to lens capsule.

Lens in situ, opaque throughout.

Retina, cone-shaped detachment, the apex at the optic nerve entrance. Some fluid vitreous contained in the retinal folds, and the sub-retinal space filled by fluid effusion. On the sides of the cone of retina are three cysts (Fig. 1), which project outwards from the retina into the sub-retinal space. One is situated on the nasal side and one superiorly, these two being at the equator of the eye, and of smaller size than the third, which is placed inferiorly and between the optic disc and the equator,

and is as large as a good-sized green pea. Their walls are thin and semi-translucent, and they contain a soft jelly-like material. There is no contact of cyst walls with choroid.

Choroid apparently normal. In the ciliary region below there is a small scar of a wound which has pierced all the coats, traversing the ciliary processes about the middle. There is some cicatricial tissue, which firmly binds together the sclera, choroid, and retina at this point.

I have not given the results of the microscopical examination of each specimen, because, with a few minor points of difference, one description will suffice for the three.

Careful examination of many sections of the retina of each specimen has been made. Case I yields the most suitable sections for microscopical examination, and from it Figs. 2 and 3 have been drawn; while Fig. 1 from Case III shows very well the naked-eye appearances of these cysts, and their relative position. In every case the cysts have developed in the retina, which is detached, the bulging always taking place *outwards*, that is, the outer layers of the retina are those which yield and become separated from the inner layers, these latter retaining their normal position in the line of the retina.

As will be seen in Fig. 2, the outer wall (so called in contradistinction to the inner or base-wall) of the cyst springs abruptly from the retina. In Case II this was particularly noticeable, the projecting wall rising from the retina almost at a right angle. The base of the cyst is usually its narrowest part. The formation of the cysts appears to begin by the formation of alveoli in the inner granule layer between Müllerian fibres, which latter have become greatly thickened and elongated. These spaces when small contain a finely fibrillated material which shrinks in hardening fluids, without any staining elements; they result, I think, not only from effusion between the Müllerian fibres, but also from the destruction of these fibres. These

small spaces coalescing, lead to the formation of the larger cyst cavity. In the base-wall of the cyst can be traced the nerve-fibre, ganglion-cell, and inner molecular layers of the retina, and in some specimens (Case I) a portion, varying in amount, of the inner granule layer. In the more advanced cysts these layers degenerate into a nucleated fibrous wall, in which no distinct elements can be made out. At the points where the outer wall leaves the line of the retina, all the layers of the retina external to, and including part of, the inner granule layer can be seen turning outwards; but, except in the earliest stages of the cyst development, they become unrecognisable almost immediately, and the wall exhibits merely a fibrillated structure of varying thickness, sometimes extremely thin, containing a greater or less number of small round staining cells.

In Case III the separation of the layers has occurred in the inter-granule layer, and the whole thickness of the inner granules can be traced along the base wall of the cyst.

In sections of a presumably young cyst (Fig. 3) the hypertrophied Müllerian fibres are seen stretching across the as yet imperfectly formed cyst; among them are large numbers of cells from the inner granule layer. Elliptical nuclei also show here and there in the course of these fibres, and are probably identical with those found in these fibres in healthy retinæ; they are, I should think, present in greater numbers than in healthy specimens. In the cyst shown in the drawing, the ganglion-cell layer in the base wall is increased in thickness, and contains a large number of small stained nuclei; in another cyst from the same eye this layer is scarcely distinguishable.

In the retina immediately adjoining the cysts, small spaces are seen in the inner granule and outer molecular layers; and it is not unlikely that the breaking down of the fibres separating them from the large cyst would lead to increase in the size of its cavity.

In all three specimens there was considerable degenera-

tion of the entire retina. The nerve-fibre and ganglion-cell layers, and the rods and cones, had chiefly suffered, and, though the granular and molecular layers (in those parts not cystic) appeared to have undergone but little change, the connective tissue elements of the retina were more than usually evident. This might be due to some atrophy of the cellular layers, but might also indicate a tendency to overgrowth of the fibrous elements, which in certain parts led to the development of the cysts.

In Specimens II and III the retinal arteries showed well-marked thickening of their coats, which had in some places a hyaline appearance.

In Specimen III a small quantity of brown pigment could be seen in the base wall of one cyst. The cysts in Cases I and III contained a jelly-like material, which had coagulated in the preservative fluid; but in Case II the contents of the cysts remained fluid, though the eyeball was hardened like the others.

The choroid and sclerotic exhibited no changes, except that in Case III the choroid was everywhere unusually thin. The hexagonal pigment in every specimen remained adherent to the choroid.

In Vol. VII of the Ophthalmic Hospital Reports is a paper by Mr. Nettleship, on "Œdema, or Cystic Disease of the Retina." The specimens to which the above remarks apply are examples, I think, of a later stage and exaggerated degree of the condition described by the author of that paper, though there are several points in which my specimens do not agree with his. In none of these cases was there any evidence of previous inflammation of the choroid, nor was there any adhesion of the cyst walls to that tunic, whereas in the specimens described in Vol. VII, there was thinning and bulging of the choroid and sclerotic at the part corresponding to the cystic retina, and adhesion between the outer cyst wall and the choroid.

In Prof. Iwanoff's papers* on "Colloid Cystic Disease

* Arch. f. Oph., 1869. Zehender's Klin. Monatsbl., 1864.

of the Retina," and "Œdema of the Retina," he states that he found the formation of spaces always beginning in the outer granule layer. In two of my specimens this was certainly not the case; in the third I have described them as apparent first in the inter-granule layer, but it is possible that they actually began in the inner half of the outer granule layer.

Cases I and III lend support to his statement that the cysts contain an albuminous fluid; a material which had coagulated, filling the cysts. In Case II, however, this was not the case.

In Vol. XIX of the Pathological Society's Transactions, Mr. Vernon gives an account of an eyeball the retina of which contained 11 small cysts. The description leaves little doubt that the specimens I have described are in many respects identical with his.

With regard to the cause of the formation of these cysts of the retina, I have nothing to suggest. They are, as mentioned previously, far from common, and present many points of interest. It is difficult to explain why the outer layers of the retina always yield; in two of these specimens the yielding may have been, and probably was, in the direction of least resistance; but in Case III the retina was not folded into a narrow stalk, and the remaining vitreous contained within was fluid; so that its resistance could hardly have been greater than that of the effusion filling the sub-retinal space. The relative strength of the internal and external limiting membranes may possibly determine the direction in which the bulging occurs. That destruction of tissue has a share, at least in the later stages, in the formation of the cyst cavities, in addition to dilatation of existing spaces, I have little doubt.

Fig 1

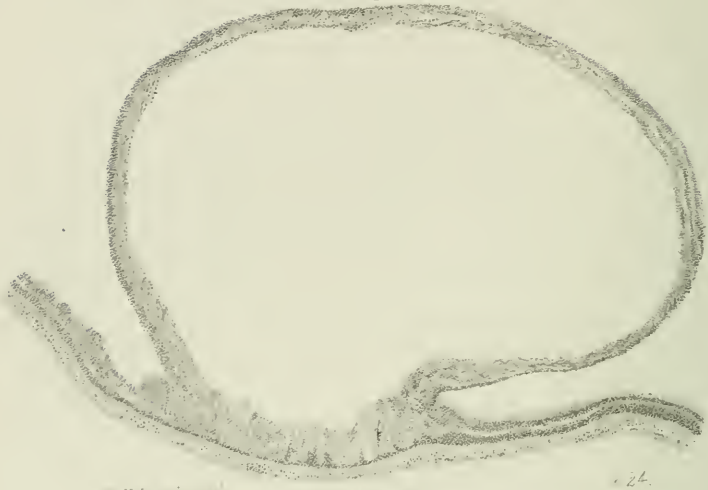
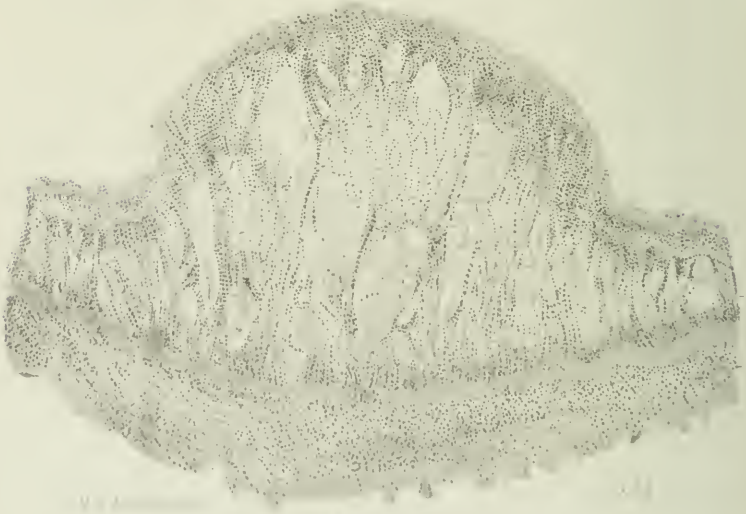


Fig 2



DESCRIPTION OF PLATE.

FIG. I. *Inner Half of Eyeball of Case III.*

Two cysts, the superior and inferior, are seen in section, and the position of a third on the nasal side of the retina is indicated by the shading between the bases of the other two. × 1½.

FIG. II. *Drawing of the Larger of the Two Cysts in Case I.*

The cyst, which has a comparatively narrow base, projects outwards, leaving the inner layers of retina undisturbed. The nerve-fibres are visible as a very thin layer; the ganglion-cell and inner molecular layers can be traced along the "base-wall" of the cyst, as can also the innermost part of the inner granules. Extending outwards from this are seen some of the hypertrophied Müllerian fibres with granules scattered among them. The external granule layer can be traced into the outer wall of the cyst for a short distance, but soon loses its distinctive characters. The rod and cone layer ceases at the point where the cyst wall projects. × 24.

FIG. III. *Section of an imperfectly formed Cyst from Case I.*

In the base-wall are seen the nerve-fibre and ganglion cell layers (*a*), these being increased in thickness and containing a large number of small cells; (*b*) the inner molecular layer. In the inner granule layer (*c*) the Müllerian fibres are shown, greatly elongated, and between them several spaces are being formed. These spaces contain a material with a finely fibrillated structure and some degenerating cells, and at the margins of some of them, ends of fibres can be seen. The intergranule and outer granule layers can be seen to turn outwards where the cyst wall begins to rise from the retina. × 52.

ON A CASE OF PERIPHERAL CHOROIDO-RETINITIS, ASSOCIATED WITH PECULIAR PIGMENTATION OF MUCOUS MEMBRANES.

By J. Hutchinson, Jun., F.R.C.S.

This patient, a woman æt. 67, attended the Great Northern Central Hospital on account of presbyopia and visual defect of the left eye. Her case presented briefly the following points of interest:—(1) Evidence of old neuro-retinitis; (2) an incomplete ring of pigmentary deposits in the periphery of the retina; (3) atrophy of the choroidal pigment, such as is seen in retinitis pigmentosa; (4) very marked dark brown and black patches in the mouth, on the lips, and on the palate; (5) general superficial glossitis (tertiary syphilitic).

It is admitted that some cases of specific choroido-retinitis closely resemble true retinitis pigmentosa, especially those due to inherited taint (Nettleship), and I may at once give the reasons against regarding this case as one of the latter affection. There was no tendency to eye disease in the family (several of the patient's brothers and sisters were living at ages varying from 50 to 70), and her parents were not related by birth. The ocular changes were not symmetrical, the right eye being practically unaffected, and the patient was sure that vision in the left eye had failed about seven years previously, the onset being sudden. Night-blindness and limitation of the field were not present, and the pigment was arranged in lines and irregular blotches rather than in the reticulated form seen in retinitis pigmentosa. The tongue presented conclusive evidence as to syphilis, although, as so commonly occurs in women, a clear history of secondaries could not be obtained. Scattered over the dorsum of the tongue (from which the papillæ had almost entirely disappeared) were superficial white scars, the remains of ulcers, of which

one or two still relapsed from time to time. There were also a few scars on the lips, but the peculiar feature here was the presence of a number of brownish-black patches, generally about 5 mm. in diameter. They were also found inside the cheeks (especially round the oral commissures), on the hard palate, and slightly on the gums. One or two were connected with faint scars, and there seemed good reason to regard them as the remains of a late syphilide, having a tendency to pigmentary deposit. The patches were much more circumscribed than those met with in Addison's disease, they were not present under the tongue nor on the general cutaneous surface, nor were there any symptoms of this affection. The eyelids were dark, but not unusually so; her general complexion was rather pale; there were some ordinary light brown freckles on the neck; there was no xanthelasma of the lids. The patient was liable to occasional attacks of constipation and languor, but had never suffered from jaundice or severe headache. She had frequently had the mouth sore as well as the tongue, so that she could hardly eat, and she believed that the dark spots appeared when the left eye failed. It may be mentioned that she had never smoked, and was very temperate as regards alcohol. She had had ulcers of the legs (possibly specific), which were now healed, but in other respects her health had been good. She had borne seven children, four of whom had died at the ages of 1 year, 3, 8, and 13 years respectively. There was no evidence as to inherited syphilis in any of them, nor of any affection of the eyes.

With the right eye V. $= \frac{15}{20}$, and with + 4 D. 1 Jaeger at 10″. The fundus showed here and there at the periphery minute spots of pigment in the retina, but the thinning of the choroid, so marked in the other eye, was here absent. T. n. and media clear in both.

In the left eye V. $= \frac{15}{50}$ (not improved by glasses):

reads 16 Jaeger, and with + 5 D. 6 Jaeger badly. The visual field was little if at all contracted. The disc was ill-defined and grey, and the vessels diminished. At various parts of the periphery of the fundus were seen the patches, lines, and stars of black pigment already mentioned. They were especially obvious in the upper segment, and were frequently placed in front of or by the side of the retinal vessels. Above the disc, at a short distance from it, were small atrophic changes, but the "punched-out" patches seen so frequently in specific choroiditis disseminata were nowhere present. In neither Liebreich's nor Jaeger's atlas is there any plate much resembling the appearances seen, though Plate XXXVIII in the latter presents a more extreme case of perhaps a similar form of disease.

An interesting question with regard to this form of choroido-retinitis is, should one regard it as a disease that is steadily aggressive and likely to affect both eyes to the same extent? Looking at the fact that the vision in the left eye had been for some years stationary in my patient, there seemed no reason for fearing a similar course in the other eye.

The coincidence of the pigmentary changes in the eye with those in the mucous membrane of the mouth seemed worthy of notice, although one would hesitate to lay much stress on it before observing other similar cases.

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Part I.

Original Contributions.

THE ACTION OF MYOTICS AND MYDRIATICS ON THE ACCOMMODATION.

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In a preceding communication (*see* p. 130) we referred to the action of eserine and pilocarpine on the pupil and on the accommodation. In this we refer to the action of homatropine and of homatropine and cocaine, and to the action of eserine on eyes to which these drugs had already been applied.

Method of Investigation.—The solutions used were—

A 2 p. c. solution of homatropine in castor oil.

A 2 p. c. solution of homatropine and of cocaine in castor oil.

A 1 p. c. solution of eserine in water.

The application has in all cases consisted of the deposition of a few drops of the solution inside the lower eyelid. The estimation of the size of the pupil has been made with a pupillometer, the same amount of light being

thrown into the eye during each measurement. The estimation of the position of the far and near points has been made by means of a "slide optometer" (constructed for us by Messrs. Pickard and Curry), similar to that now in use in Utrecht. Measurements have been made in one meridian only (vertical).

In order to bring the points within measurable distance the eyes observed were always rendered myopic by convex lenses. The lenses were always placed very close to the eye, so that the nodal point was not materially altered in position, and consequently the ranges of accommodation given represent very nearly the true range.

I. *The Action of Homatropine.*

The following six tables show the effect produced on the pupil and accommodation apparatus by the single application of a 2 p. c. solution of homatropine in castor oil:—

Case I.—A. D., æt. 25. *Right Eye.* V. $= \frac{6}{6}$ partly, $\bar{c}$ +0·75 D. cyl. axis vert. $= \frac{6}{6}$.

Time.	Pupil.	Near point.
Before application ...	5 mm.	15 cm.
After application—		
5 minutes	5 ,,	16 ,,
10 ,, ...	5 ,,	16 ,,
15 ,, ...	5·5 ,,	19 ,,
20 ,, ...	6 5 ,,	21 ,,
25 ,, ...	7 ,,	22 ,,
30 ,, ...	7·5 ,,	25 ,,
35 ,, ...	7·5 ,,	29 ,,
40 ,, ...	8 ,,	36 ,,
45 ,, ...	8 ,,	54 ,,
50 ,, ...	8 ,,	74 ,,
55 ,, ...	8 ,,	105 ,,
60 ,, ...	8 ,,	120 ,,
65 ,, ...	8 ,,	210 ,,
6 hours	..	Almost in original position.
10 hours	..	Recovered completely.

In this case the position of the far point was not estimated throughout. The position has therefore in our calculations been assumed to be invariable.

In this case the application of homatropine caused—

(1.) A dilatation of the pupil, which began at the 15th minute, and reached its maximum at the 40th.

(2.) A recession of the near point, which began at the 5th minute, and reached its maximum at the 65th, and disappeared in 10 hours. This recession at its maximum was equivalent to 6·19 D.

(3.) A diminution of the range of accommodation, which began at the 5th minute, reached its maximum at the 65th minute, and disappeared in 10 hours. This decrease at its maximum amounted to 6·19 D., that is, 0·93 of the normal range (6·67 D.), so that the total range was then 0·48 D.

Case II.—R. D., æt. 23. *Left Eye.* V. $= \frac{6}{9}\bar{c}\frac{-0{\cdot}25\text{ D.}}{-{\cdot}5\text{ D. cyl. vert.}} = \frac{6}{6}$.

A +0·75 D. Spherical Lens was worn during this Observation.

Time.	Pupil.	Near point.	Far point.
Before application ...	4 mm.	10 cm.	100 cm.
After application—			
5 minutes	4 ,,	11 ,,	100 ,,
10 ,, ...	4 ,,	15 ,,	85 ,,
15 ,, ...	4 ,,	21 ,,	90 ,,
20 ,, ...	4·5 ,,	20 ,,	90 ,,
25 ,, ...	5·5 ,,	25 ,,	85 ,,
30 ,, ...	6 ,,	29 ,,	75 ,,
35 ,, ...	6·5 ,,	35 ,,	75 ,,
40 ,, ...	6·5 ,,	25 ,,	88 ,,
45 ,, ...	7·5 ,,	35 ,,	75 ,,
50 ,, ...	8 ,,	37 ,,	78 ,,
55 ,, ...	8 ,,	47 ,,	75 ,,
60 ,, ...	8 ,,	45 ,,	77 ,,
65 ,, ...	8 ,,	52 ,,	71 ,,
70 ,, ...	9 ,,	43 ,,	73 ,,
75 ,, ...	9 ,,	50 ,,	68 ,,
80 ,, ...	..	50 ,,	72 ,,
85 ,, ...	..	49 ,,	59 ,,
90 ,, ...	..	50 ,,	65 ,,
95 ,, ...	..	50 ,,	68 ,,
100 ,, ...	9 ,,	52 ,,	75 ,,
150 ,, ...	9 ,,	34 ,,	80 ,,
165 ,, ...	9 ,,	36 ,,	
4 hours	..	28 ,,	
6 ,, ...	..	18 ,,	
8 ,, ...	..	13 ,,	
10·5 ,, ...	..	10 ,,	
36 ,, ...	normal		

In this case the application of homatropine caused—

(1.) A dilatation of the pupil, which began at the 20th minute, reached its maximum at the 70th minute, and disappeared in 36 hours.

(2.) A recession of the near point, which began at the 5th minute, reached its maximum at the 65th minute, and disappeared in 10·5 hours. The maximum recession was equivalent to 8·08 D.

(3.) An approximation of the far point, which began at the 10th minute, reached its maximum at the 85th, and was then equivalent to 0·69 D.

(4.) A diminution in the range of accommodation, which began at the 5th minute, reached its maximum at the 85th minute, and disappeared in 10·5 hours. This decrease at its maximum amounted to 8·65 D.; that is, 0·96 of the normal range (9 D.), so that the total range was then 0·35 D.

Case III.—C. P., æt. 20. *Left Eye.* V. $= \frac{6}{6}$. Hm. 0·75 D.

A +1·75 D. Spherical Lens was worn during the Observation.

Time.	Pupil.	Near point.	Far point.
Before application....	3 mm.	10 cm.	98 cm.
After application—			
5 minutes	3 ,,	11 ,,	100 ,,
10 ,, ...	3·5 ,,	11 ,,	100 ,,
15 ,, ...	6 ,,	15 ,,	78 ,,
20 ,, ...	7 ,,	17 ,,	77 ,,
25 ,, ...	7 ,,	18 ,,	78 ,,
30 ,, ...	7·5 ,,	29 ,,	76 ,,
35 ,, ...	7·5 ,,	30 ,,	87 ,,
40 ,, ...	7·5 ,,	34 ,,	86 ,,
45 ,, ...	7·5 ,,	41 ,,	85 ,,
50 ,, ...	7·5 ,,	49 ,,	75 ,,
55 ,, ...	7·5 ,,	50 ,,	74 ,,
60 ,, ...	7·5 ,,	47 ,,	73 ,,
70 ,, ...	7·5 ,,	45 ,,	66 ,,
80 ,, ...	8 ,,	53 ,,	74 ,,
90 ,, ...	8 ,,	40 ,,	71 ,,
100 ,, ...	8 ,,	44 ,,	81 ,,
110 ,, ...	8 ,,	37 ,,	87 ,,
120 ,, ...	8 ,,	36 ,,	90 ,,
130 ,, ...	8 ,,	34 ,,	93 ,,
140 ,, ...	8 ,,	29 ,,	97 ,,
12 hours	..	normal	
36 ,, ...	normal		

In this case the application of homatropine caused—

(1.) A dilatation of the pupil, which began at the 10th minute, reached its maximum at the 80th minute, and disappeared in 36 hours.

(2.) A recession of the near point, which began at the 5th minute, reached its maximum at the 80th minute, and disappeared in 12 hours. This recession at its maximum was equivalent to 8·11 D.

(3.) An approximation of the far point, which began at the 15th minute, and reached its maximum at the 70th minute; it was then equivalent to 0·49 D.

(4.) A diminution in the range of accommodation, which began at the 5th minute, reached its maximum at the 80th minute, and disappeared in 12 hours. This decrease at its maximum amounted to 8·44 D.; that is, 0·914 of the normal range (8·98 D.), so that the total range was then 0·54 D.

Case IV.—P., æt. 21. *Left Eye.* V. $= \frac{6}{6}$. Emmetropic.

A +2 D. Spherical Lens worn during the Observation.

Time.	Pupil.	Near point.	Far point.
Before application....	4 mm.	12 cm.	33 cm.
After application—			
5 minutes	4·5 ,,	13 ,,	33 ,,
10 ,, ...	6·5 ,,	16 ,,	30 ,,
15 ,, ...	8 ,,	17 ,,	44 ,,
20 ,, ...	8 ,,	17 ,,	48 ,,
25 ,, ...	8·5 ,,	18 ,,	50 ,,
30 ,, ...	9 ,,	18 ,,	50 ,,
35 ,, ...	9 ,,	23 ,,	48 ,,
40 ,, ...	9 ,,	23 ,,	52 ,,
45 ,, ...	9 ,,	29 ,,	53 ,,
50 ,, ...	9 ,,	32 ,,	50 ,,
55 ,, ...	9 ,,	33 ,,	61 ,,
60 ,, ...	9 ,,	35 ,,	60 ,,
65 ,, ...	9 ,,	40 ,,	65 ,,
70 ,, ...	9 ,,	32 ,,	62 ,,
75 ,, ...	9 ,,	36 ,,	66 ,,
80 ,, ...	9 ,,	39 ,,	73 ,,
85 ,, ...	9 ,,	39 ,,	63 ,,
90 ,, ...	9 ,,	36 ,,	66 ,,
95 ,, ...	9 ,,	38 ,,	63 ,,
100 ,, ...	9 ,,	39 ,,	76 ,,

CASE IV—*continued.*

Time.	Pupil.	Near point.	Far point.
After application—			
105 minutes	9 mm.	37 cm.	65 cm.
5 hours	..	21 „	
7 „	..	13 „	
9 „	..	12 „	
19 „	normal		

In this case the application of the homatropine caused—

(1.) A dilatation of the pupil, which began at the 5th minute, reached its maximum at the 30th minute, and disappeared in 19 hours.

(2.) A recession of the near point, which began at the 5th minute, reached its maximum at the 65th minute, and disappeared in 9 hours. The maximum recession was equivalent to 5·83 D.

(3.) A recession of the far point, which began at the 15th minute, reached its maximum at the 100th minute, and was then equivalent to 1·72 D.

(4.) A diminution in the range of accommodation, which began at the 5th minute, reached its maximum at the 65th minute, and disappeared in 9 hours. This decrease at its maximum amounted to 4·34 D.; that is, 0·81 of the normal range (5·3 D.), so that the total range was then 0·96 D.

Case V.—A., æt. 23. *Left Eye.* V. $= \frac{6}{6}$. Hm. 0·5 D.

A +2 D. Spherical Lens was worn during this Observation.

Time.	Pupil.	Near point.	Far point.
Before application....	2·5 mm.	12 cm.	67 cm.
After application—			
5 minutes	2·5 ,,	13 ,,	90 ,,
10 ,, ...	2·5 ,,	15 ,,	91 ,,
15 ,, ...	3 ,,	15 ,,	100 ,,
20 ,, ...	3 ,,	18 ,,	89 ,,
25 ,, ...	4·5 ,,	27 ,,	100 ,,
30 ,, ...	5 ,,	40 ,,	102 ,,
35 ,, ...	5·5 ,,	35 ,,	91 ,,
40 ,, ...	5·5 ,,	37 ,,	87 ,,
45 ,, ...	6 ,,	35 ,,	90 ,,
50 ,, ...	6·5 ,,	33 ,,	75 ,,
55 ,, ...	6·5 ,,	33 ,,	80 ,,
60 ,, ...	6·5 ,,	30 ,,	82 ,,
65 ,, ...	7 ,,	29 ,,	84 ,,
70 ,, ...	6·5 ,,	31 ,,	99 ,,
80 ,, ...	6·5 ,,	29 ,,	91 ,,
90 ,, ...	7·5 ,,	29 ,,	92 ,,
100 ,, ...	7·5 ,,	29 ,,	87 ,,
5 hours	..	12 ,,	
24 ,, ...	normal		

In this case the application of homatropine caused—

(1.) A dilatation of the pupil, which began at the 15th minute, reached its maximum at the 90th minute, and disappeared in 24 hours.

(2.) A recession of the near point, which began at the 5th minute, reached its maximum at the 30th minute, and disappeared in 5 hours. The maximum recession was equivalent to 5·83 D.

(3.) A recession of the far point, which began at the 5th minute, and reached its maximum at the 30th minute, and was then equivalent to 0·51 D.

(4.) A diminution of the range of accommodation, which began at the 5th minute, reached its maximum at the 30th minute, and disappeared in 5 hours. This diminution at its maximum amounted to 5·32 D.: that is, 0·78 of

the normal range (6·84 D.), so that the total range was then 1·52 D.

Case VI.—S., æt. 22. *Left Eye.* V. $= \frac{6}{12}\,\bar{c} - 0{\cdot}75$ D. $\frac{6}{6}$.

A +0·5 D. Spherical Lens was worn during the Observation.

Time.	Pupil.	Near point.	Far point.
Before application....	3·5 mm.	14 cm.	90 cm.
After application—			
5 minutes	3·5 „	14 „	85 „
10 „	3·5 „	14 „	89 „
15 „	4·5 „	16 „	92 „
20 „	5 „	18 „	91 „
25 „	6·5 „	19 „	89 „
30 „	6 „	23 „	90 „
35 „	6·5 „	23 „	89 „
40 „	7 „	26 „	94 „
45 „	7 „	29 „	99 „
50 „	7·5 „	26 „	98 „
55 „	7·5 „	28 „	93 „
60 „	7·5 „	28 „	100 „
65 „	7·5 „	31 „	100 „
70 „	7·5 „	29 „	100 „
75 „	7·5 „	26 „	100 „
80 „	7·5 „	26 „	96 „
85 „	7·5 „	26 „	97 „
90 „	7·5 „	25 „	100 „
105 „	7·5 „	26 „	100 „
3 hours	..	26 „	
4 „	..	19 „	
5 „	..	17 „	
6 „	..	14 „	
15 „	normal		

In this case the application of homatropine caused—

(1.) A dilatation of the pupil, which began at the 15th minute, reached its maximum at the 50th minute, and disappeared in 15 hours.

(2.) A recession of the near point, which began at the 15th minute, reached its maximum at the 65th minute, and disappeared in 6 hours. The maximum recession was equivalent to 3·92 D.

(3.) A variability in the position of the far point; the

maximum approximation occurred at the 5th minute, and was equivalent to 0·07 D. The maximum recession occurred at the 60th minute, and was equivalent to 0·11 D.

(4.) A diminution of the range of accommodation, which began at the 5th minute, reached its maximum at the 65th minute, and disappeared in 6 hours. This decrease at its maximum amounted to 3·81 D.; that is, 0·63 of the normal range (6·03 D.), so that the total range was then 23·22 D.

Summary.—It seems, then, that the application of homatropine caused—

(1.) A dilatation of the pupil, which began from the 5th to the 20th minute, reached its maximum between the 30th and 90th minutes, and disappeared in from 15 to 36 hours.

(2.) A recession of the near point, which began between the 5th and 15th minutes, reached its maximum between the 30th and 80th minutes, and disappeared in from 6 to 12 hours. The maximum recession was equivalent to from 3·92 D. to 8·11 D.

(3.) A variability in the position of the far point. The maximum recession occurred between the 30th and 100th minutes, and was equivalent to from 0·11 D. to 1·72 D. The maximum approximation occurred between the 5th and 85th minutes, and was equivalent to from 0·67 D. to 0·69 D.

(4.) A diminution of the range of accommodation, which began at the 5th minute, reached its maximum between the 30th and 85th minutes, and disappeared in from 5 to 10·5 hours. This diminution at its maximum was equivalent to from 3·81 D. to 8·65 D., or from 0·63 to 0·96 of the normal range (5·3 D. to 9 D.). The total range at the time of maximum diminution was from 0·35 D. to 2·22 D.

Taking averages, it seems that the application caused—

(1.) A dilatation of the pupil, which began at the 13·33 minute, reached its maximum at the 60th minute, and disappeared in 21·67 hours.

(2.) A recession of the near point, which began at the 6·67 minute, reached its maximum at the 61·67 minute, and disappeared in 8·75 hours. The maximum recession was equivalent to 6·33 D.

(3.) A variability in the position of the far point. The maximum recession occurred at the 63·33 minute, and was equivalent to 0·78 D. The maximum approximation occurred at the 53·33 minute, and was equivalent to 0·42 D.

(4.) A diminution of the range of accommodation, which began at the 5th minute, reached its maximum at the 65th minute, and disappeared in 8·75 hours. The diminution at its maximum was equivalent to 6·12 D.; that is, 0·86 of the normal range (7·14 D.), so that the total range was then 1·01 D. (*See* Chart I.)

Remarks.—The variability in the position of the far point demands explanation. The slight approximation which often occurred seemed to be caused by the dilatation of the pupil, since the application of a diaphragm with a small aperture to the eye caused the far point to recede materially. The recession seemed to be caused by the paralysis of the ciliary muscle, and the consequent transference of latent into manifest hypermetropia.

II. *The Action of Homatropine + Cocaine.*

The following six tables show the action on the pupil and accommodation of a single application of a solution of homatropine (2 p. c.) + cocaine (2 p. c.) in castor oil.

CASE I.—*Right Eye.* V. $= \frac{6}{5}$ Emmetropic. A +2 D. Spherical Lens worn during Observation.

Time.	Pupil.	Near point.	Far point.
Before application	4 mm.	12 cm.	34 cm.
After application—			
5 minutes	5 „	13 „	33 „
10 „	9 „	17 „	34 „
15 „	10 „	20 „	34 „
20 „	10 „	24 „	47 „
25 „	10 „	29 „	58 „
30 „	10 „	34 „	59 „ V$\bar{c}$ + 0·5 D. $= \frac{6}{6}$
35 „	10 „	40 „	63 „
40 „	10 „	43 „	65 „
45 „	10 „	45 „	69 „
50 „	10 „	50 „	68 „
55 „	10 „	53 „	72 „ V$\bar{c}$ + 0·75 D. $= \frac{6}{6}$
60 „	10 „	56 „	75 „
65 „	10 „	62 „	84 „ V$\bar{c}$ + 1 D. $= \frac{6}{6}$
70 „	10 „	50 „	89 „
75 „	10 „	56 „	86 „
80 „	10 „	56 „	91 „
85 „	10 „	53 „	90 „
90 „	10 „	49 „	87 „
95 „	10 „	51 „	88 „
100 „	10 „	51 „	86 „
105 „	10 „	50 „	87 „
19 hours	..	normal	85 „
48 „	normal		

In this case the application of homatropine + cocaine caused—

(1.) A dilatation of the pupil, which began at the 5th minute, reached its maximum at the 15th, and disappeared in 48 hours.

(2.) A recession of the near point, which began at the 5th minute, reached its maximum at the 65th minute, and disappeared in 19 hours. The maximum recession was equivalent to 6·72 D.

(3.) A recession of the far point, which began at the 13th minute, and reached its maximum at the 75th minute. The maximum recession was equivalent to 1·84 D.

(4.) A diminution of the range of accommodation, which began at the 5th minute, reached its maximum at the 65th minute, and disappeared in 19 hours. This decrease at its maximum amounted to 4·9 D., that is, 0·91 of the normal range (5·39 D.), so that the total range was then 0·49 D.

Case II.—A., æt. 23. *Right Eye.* $V^c \frac{+3 \text{ D sph.}}{+0{\cdot}75 \text{ D cyl. } 70° \text{ out}} = \frac{6}{6}$. A +5 D. Spherical Lens worn during the Observation.

Time.	Pupil.	Near point.	Far point.
Before application ...	2·5 mm.	14 cm.	61 cm.
After application—			
5 minutes	2·5 „	16 „	51 „
10 „	3 „	24 „	68 „
15 „	4 „	35 „	80 „
20 „	5·5 „	50 „	100 „
25 „	6·5 „	58 „	103 „
30 „	7·5 „	75 „	105 „
35 „	7·5 „	62 „	101 „
40 „	8 „	58 „	102 „
45 „	9 „	66 „	100 „
50 „	9 „	55 „	107 „
55 „	9 „	49 „	103 „
60 „	9 „	51 „	95 „
65 „	9 „	53 „	100 „
70 „	9 „	44 „	95 „
80 „	9 „	49 „	102 „
90 „	9 „	43 „	87 „
100 „	9 „	40 „	90 „
48 hours	normal	normal	

In this case the application of homatropine + cocaine caused—

(1.) Dilatation of the pupil, which began at the 10th minute, reached its maximum at the 45th minute, and disappeared in 48 hours.

(2.) A recession of the near point, which began at the 5th minute, reached its maximum at the 30th minute, and disappeared in 48 hours. The maximum recession was equivalent to 5·81 D.

(3.) A recession of the far point, which began at the 10th minute, and virtually reached its maximum at the 30th minute (the actual maximum was reached at the 50th minute). The maximum recession was equivalent to 0·71 D.

(4.) A diminution of the range of accommodation, which began at the 5th minute, reached its maximum at the 30th minute, and disappeared in 48 hours. This decrease at its maximum amounted to 5·12 D., that is, 0·91 D. of the normal range (5·5 D.), so that the total range was then 0·38 D.

Case III.—S., æt. 22. *Right Eye.* $\frac{6}{24}$ c 1·5 D. = $\frac{6}{18}$ partly.

Time.	Pupil.	Near point.	Far point.
Before application ...	3·5 mm.	13 cm.	58 cm.
After application—			
5 minutes	3·5 „	13 „	50 „
10 „	3·5 „	14 „	48 „
15 „	4·5 „	17 „	47 „
20 „	5 „	21 „	58 „
25 „	6·5 „	23 „	59 „
30 „	6·5 „	26 „	57 „
35 „	7 „	29 „	63 „
40 „	7·5 „	29 „	55 „
45 „	7·5 „	28 „	58 „
50 „	8 „	30 „	56 „
55 „	8 „	36 „	65 „
60 „	8 „	31 „	55 „
65 „	8 „	29 „	60 „
70 „	8 „	30 „	60 „
75 „	8 „	31 „	62 „
80 „	8 „	29 „	64 „
85 „	8 „	29 „	69 „
90 „	8 „	30 „	72 „
105 „	8 „	29 „	72 „
3 hours	..	27 „	68 „
4 „	..	19 „	
5 „	..	normal	
15 „	normal		

In this case the application of homatropine + cocaine caused—

(1.) A dilatation of the pupil, which began at the 15th

minute, reached its maximum at the 50th minute, and disappeared in 15 hours.

(2.) A recession of the near point, which began at the 10th minute, reached its maximum at the 55th minute, and disappeared in less than 15 hours. The maximum recession was equivalent to 4·91 D.

(3.) A variability in the position of the far point, the maximum approximation being reached at the 15th minute, and the maximum recession at the 90th minute. The maximum approximation was equivalent to 0·41 D., and the maximum recession to 0·74 D.

(4.) A diminution of the range of accommodation, which began at the 5th minute, reached its maximum at the 55th minute, and disappeared in less than 15 hours. The decrease at its maximum amounted to 4·73 D., that is, 0·79 of the normal range (5·97 D.), so that the total range was then 1·24 D.

Case IV.—C. P., æt. 20. *Right Eye.* V. $= \frac{6}{6}$. Hm. 1 D.

A +2 D. Spherical Lens worn during Observation.

Time.	Pupil.	Near point.	Far point.
Before application....	3 mm.	11 cm.	98 cm.
After application—			
5 minutes	4·5 „	12 „	92 „
10 „	8 „	13 „	91 „
15 „	9 „	17 „	96 „
20 „	10 „	23 „	85 „
25 „	10 „	31 „	83 „
30 „	10 „	41 „	89 „
35 „	10 „	50 „	91 „
40 „	10 „	50 „	88 „
45 „	10 „	49 „	94 „
50 „	10 „	52 „	82 „
60 „	10 „	51 „	99 „
70 „	9 „	56 „	96 „
80 „	9·5 „	49 „	94 „
90 „	9 „	49 „	100 „
100 „	9 „	50 „	107 „
110 „	9 „	44 „	107 „
120 „	9 „	43 „	112 „
130 „	9 „	41 „	109 „
140 „	9 „		
24 hours	normal	normal	

In this case the application of homatropine + cocaine caused—

(1.) A dilatation of the pupil, which began at the 5th minute, reached its maximum at the 20th minute, and disappeared in 24 hours.

(2.) A recession of the near point, which began at the 5th minute, reached its maximum at the 70th minute, and disappeared in 24 hours. The maximum recession was equivalent to 7·31 D.

(3.) A variability in the position of the far point, the maximum approximation being reached at the 50th minute, and the maximum recession at the 120th minute. The maximum approximation was equivalent to 0·2 D., and the maximum recession to 0·13 D.

(4.) A diminution of the range of accommodation, which began at the 5th minute, reached its maximum at the 50th minute, and disappeared in 24 hours. The decrease at its maximum amounted to 7·73 D., that is, 0·91 of the normal range (8·07 D.), so that the total range was then 0·7 D.

Case V.—J. W. B., æt. 24. *Left Eye.* V. $= \frac{6}{6}$. Under Homatropine. V. $= \frac{6}{9}$, $\bar{c}$ − ·25 D. cyl. $= \frac{6}{5}$. A + 1·5 D. Spherical Lens was worn during the Observation.

Time.	Pupil.	Near point.	Far point.
Before application....	4·5 mm.	8 cm.	50 cm.
After application—			
5 minutes	4·5 ,,	8 ,,	50 ,,
10 ,, ...	5·5 ,,	13 ,,	50 ,,
15 ,, ...	9 ,,	18 ,,	57 ,,
20 ,, ...	9·5 ,,	24 ,,	52 ,,
25 ,, ...	10 ,,	23 ,,	52 ,,
30 ,, ...	10 ,,	27 ,,	56 ,,
35 ,, ...	10 ,,	32 ,,	57 ,,
40 ,, ...	10 ,,	32 ,,	57 ,,
45 ,, ...	10 ,,	33 ,,	59 ,,
50 ,, ...	10 ,,	36 ,,	60 ,,
55 ,, ...	10 ,,	35 ,,	56 ,,

CASE V—*continued.*

Time.	Pupil.	Near point.	Far point.
After application—			
60 minutes	10 mm.	37 cm.	58 cm.
65 „	10 „	37 „	57 „
70 „	10 „	36 „	57 „
80 „	10 „	37 „	59 „
4 hours	10 „	28 „	
8 „	10 „	22 „	
12 „	10 „	9 „	
24 „	6 „	normal	
32 „	6 „ (active)		
48 „	normal		

In this case the application of homatropine + cocaine caused—

(1.) A dilatation of the pupil, which began at the 10th minute, reached its maximum at the 25th, and disappeared in 48 hours.

(2.) A recession of the near point, which began in 10 minutes, reached its maximum at the 60th minute, and disappeared in 24 hours. The maximum recession was equivalent to 9·8 D.

(3.) A recession of the far point, which began at the 15th minute, and reached its maximum at the 50th minute. The maximum recession was equivalent to 0·33 D.

(4.) A diminution of the range of accommodation, which began at the 10th minute, reached its maximum at the 65th minute, and disappeared in 24 hours. The decrease at its maximum amounted to 9·55 D., that is, 0·91 of the normal range (10·5 D.), so that the total range was then 0·95 D.

Case VI.—R. D., æt. 23. — *Right Eye.* V. $= \frac{6}{18}$ c $\frac{-0{\cdot}5 \text{ D.}}{-0{\cdot}5 \text{ D. cyl. axis vert.}} = \frac{6}{5}$. A +0·5 D. Spherical Lens was worn during the Observation.

Time.	Pupil.	Near point.	Far point.
Before application....	4 mm.	11 cm.	90 cm.
After application—			
5 minutes	4 „	12 „	85 „
10 „	4 „	12 „	89 „
15 „	8 „	17 „	65 „
20 „	9 „	50 „	70 „
25 „	10 „	45 „	70 „
30 „	10 „	40 „	70 „
35 „	10 „	35 „	75 „
40 „	10 „	40 „	68 „
45 „	10 „	35 „	70 „
50 „	10 „	35 „	62 „
55 „	10 „	45 „	70 „
60 „	10 „	46 „	70 „
65 „	10 „	48 „	68 „
70 „	10 „	50 „	62 „
75 „	10 „	47 „	63 „
80 „	10 „	50 „	70 „
85 „	10 „	50 „	56 „
90 „	10 „	55 „	61 „
95 „	10 „	50 „	57 „
105 „	10 „	50 „	65 „
155 „	10 „	41 „	68 „
170 „	10 „	46 „	67 „
4 hours	..	35 „	
10·5 „	..	17 „	
24 „	normal	normal	

In this case the application of homatropine + cocaine caused—

(1.) A dilatation of the pupil, which began at the 15th minute, reached its maximum at the 25th minute, and disappeared in 24 hours.

(2.) A recession of the near point, which began at the 5th minute, reached its maximum at the 90th minute, and disappeared in 24 hours. The maximum recession was equivalent to 7·27 D.

(3.) An approximation of the far point, which began at the 5th minute, and reached its maximum at the 85th

minute. The maximum approximation was equivalent to 0·67 D.

(4.) A diminution in the range of accommodation, which began at the 5th minute, reached its maximum at the 90th minute, and disappeared in 24 hours. The decrease at its maximum amounted to 7·8 D., that is, 0·98 of the normal range (7·98 D.), so that the total range was then 0·18 D.

Summary.—It seems then that the application of homatropine + cocaine caused—

(1.) A dilatation of the pupil, which began between the 5th and 15th minutes, reached its maximum between the 15th and 50th minutes, and disappeared in from 15 to 48 hours.

(2.) A recession of the near point, which began between the 5th and 10th minutes, reached its maximum between the 30th and 90th minutes, and disappeared in from 15—48 hours. The maximum approximation was equivalent to from 4·91 D. to 9·8 D.

(3.) A variability in the position of the far point. The maximum approximation occurred between the 15th and 85th minutes, and was equivalent to from 0·2 D. to 0·67 D. The maximum recession occurred between the 50th and 120th minutes, and was equivalent to from 0·13 D. to 1·84 D.

(4.) A diminution of the range of accommodation, which began between the 5th and 10th minutes, reached its maximum between the 30th and 90th minutes, and disappeared in from 15—48 hours. The maximum diminution was from 4·73 D. to 9·55 D., that is, 0·79 to 0·98 of the normal range (5·39 to 10·5 D.), so that the total range was then 0·18 D. to 1·24 D.

Taking averages, it seems that the application caused—

(1.) A dilatation of the pupil, which began at the 10th minute, reached its maximum at the 30th minute, and disappeared in 34·5 hours.

(2.) A recession of the near point, which began at the 6·67 minute, reached its maximum at the 61·67 minute, and disappeared in 25·67 hours. The maximum recession was equivalent to 6·97 D.

(3.) A variability in the position of the far point. The maximum approximation occurred at the 50th minute, and was equivalent to 0·43 D. The maximum recession occurred at the 77th minute, and was equivalent to 0·75 D.

(4.) A diminution of the range of accommodation, which began at the 5·83 minute, reached its maximum at the 59·17 minute, and disappeared in 25·67 hours. The maximum diminution was equivalent to 6·58 D., that is, 0·91 D. of the normal range (7·23 D.), so that the total range was then 0·66 D. (*See* Chart II.)

Comparison of the Actions of Homatropine and of Homatropine + Cocaine.

A survey of the table on page 238 shows—

(1.) That homatropine + cocaine dilates the pupil more rapidly than homatropine alone, and that the effect lasts longer.

(2.) That homatropine + cocaine alters the position of the far and near points in about the same time as homatropine alone. The effect on the near point lasts much longer. The amount of action is somewhat greater in the case of homatropine with cocaine.

(3.) That homatropine + cocaine causes a slightly more rapid and a greater diminution of the range of accommodation than homatropine alone, the accommodation being nearly reduced to *nil* by their influence.

Practical Deduction.—That for ophthalmoscopic and similar purposes the application of homatropine + cocaine to paralyse the sphincter pupillæ and ciliary muscle produces better results than those produced by homatropine alone, and in a shorter period of time.

Table showing the Action of Homatropine and of Homatropine + Cocaine.

		Dilatation of pupil.	Recession of near point.	Variability in position of far point.		Diminution of range of accommodation.
				Approximate.	Recession.	
Time of commencement of action.	Homatropine	13·33 mins.	6·67 mins.	..	..	5 mins.
	Homatropine + cocaine	10 „	6·67 „	..	..	5·83 mins.
Time of maximum action.	Homatropine	60 „	61·67 „	53·33 mins.	63·33 mins.	65 mins.
	Homatropine + cocaine	30 „	61·67 „	50 „	77 „	59·17 mins.
Time of cessation of action.	Homatropine	21·67 hours	8·75 hours	..	..	8·75 hours.
	Homatropine + cocaine	34·5 „	25·67 „	..	..	25·67 „
Amount of maximum action.	Homatropine	..	6·33 D.	0·42 D.	0·78 D.	6·12 D. or 0·86 of the normal range 7·14 D. so that the total range was then 1·01 D.
	Homatropine + cocaine	..	6·97 D.	0·42 D.	0·75 D.	6·58 D. or 0·91 of the normal range 7·23 D. so that the total range was 0·66 D.

III. *The Action of Homatropine with Eserine.*

Case I.—P., æt. . *Right Eye.* V. $= \frac{6}{5}$. Emmetropic. A +2 D. Spherical Lens worn during the Observation.

Time.	Pupil.	Near point.	Far point.
Before application.....	4 mm.	13 cm.	42 cm.
After application—			
5 minutes	4 „	13 „	39 „
10 „	5 „	16 „	42 „
15 „	7·5 „	16 „	47 „
20 „	7·5 „	19 „	45 „
25 „	8·5 „	17 „	44 „
30 „	9 „	22 „	49 „
35 „	9 „	26 „	47 „
40 „	9·5 „	28 „	47 „
45 „	9·5 „	26 „	48 „
50 „	9·5 „	26 „	50 „
55 „	9·5 „	31 „	51 „
60 „	9·5 „	30 „	51 „
65 „	9·5 „	35 „	56 „
70 „	9·5 „	28 „	48 „
75 „	9·5 „	29 „	49 „
80 „ (eserine applied)	9·5 „	30 „	53 „
85 „	9·5 „	14 „	16 „
90 „	7 „	12 „	12 „
95 „	3·5 „	11 „	12 „
100 „	2·5 „	9 „	11 „
105 „	2 „	9 „	11 „
110 „	2 „	10 „	11 „
115 „	2 „	10 „	11 „
120 „	2 „	11 „	12 „
125 „	2 „	11 „	15 „
130 „	2 „	12 „	20 „
20 hours	still contracted	normal	
44 „	still slightly smaller than opposite one		

In this case the application of homatropine caused—

(1.) A dilatation of the pupil (4 mm.), which began at the 10th minute, and reached its maximum at the 40th minute. Whilst in this condition, at the 80th minute, eserine was applied, and caused a contraction of the pupil, which began at the 90th minute, and reached its maximum (2 mm.) at the 105th minute.

(2.) A recession of the near point, which began at the

10th minute, and reached its maximum at the 65th, and was then equivalent to 4·83 D. At the 80th minute, while the recession was still great, eserine was applied and caused an approximation, which began at the 85th minute, and reached its maximum at the 100th minute. The maximum approximation was equivalent to 7·78 D. The near point was therefore 4 cm. (3·42 D.) nearer to the eye than at first.

(3.) A recession of the far point, which began at the 15th minute, reached its maximum at the 65th minute, and was then equivalent to 0·6 D. At the 80th minute, when it was much receded, eserine was applied and caused an approximation, which began at the 85th, reached its maximum at the 100th, and was then equivalent to 7·2 D. The far point was therefore 31 cm. (6·71 D.) nearer to the eye than at first.

(4.) A diminution of the range of accommodation, which began at the 5th minute, and reached its maximum at the 65th minute. This decrease at its maximum was equivalent to 4·23 D., that is, 0·79 of the normal range (5·31 D.), so that the total range was then 1·08 D. At the 80th minute, when the range was still greatly decreased (by 3·87 D.), eserine was applied, and caused a temporary disappearance of accommodation at the 90th minute.

Case II.—A., æt. 23. *Right Eye.* V. $= \frac{6}{6}\,\bar{c}\,\frac{+3\text{ D.}}{+0{\cdot}75\text{ D. cyl.}}$

A +5 D. Spherical Lens was worn during the Observation.

Time.	Pupil.	Near point.	Far point.
Before application	3 mm.	16 cm.	84 cm.
After application—			
5 minutes	3 ,,	17 ,,	95 ,,
10 ,,	3 ,,	17 ,,	72 ,,
15 ,,	3 ,,	18 ,,	79 ,,
20 ,,	3·5 ,,	19 ,,	84 ,,
25 ,,	3·5 ,,	24 ,,	79 ,,
30 ,,	3·5 ,,	24 ,,	85 ,,
35 ,,	4 ,,	31 ,,	87 ,,
40 ,,	5 ,,	28 ,,	92 ,,
45 ,,	5 ,,	32 ,,	92 ,,

CASE II—*continued.*

Time.	Pupil.	Near point.	Far point.
After application—			
50 minutes	5 mm.	34 cm.	98 cm.
55 „	5·5 „	32 „	97 „
60 „	5 „	34 „	98 „
65 „	5·5 „	35 „	99 „
70 „	5·5 „	40 „	95 „
75 „	5·5 „	39 „	103 „
80 „	5·5 „	35 „	94 „
85 „	5·5 „	34 „	94 „
90 „	5·5 „	30 „	102 „
95 „ (eserine applied)	6 „	29 „	100 „
100 „	5 „	22 „	64 „
105 „	5 „	16 „	28 „
110 „	5 „	16 „	23 „
115 „	5 „	15 „	21 „
120 „	4·5 „	14 „	24 „
125 „	4 „	16 „	22 „
130 „	4 „	16 „	24 „ V. $= \frac{6}{5}$.
3·5 hours	normal	normal	

In this case the application of homatropine caused—

(1.) A dilatation of the pupil (3 mm.), which began at the 20th minute, and reached its maximum at the 95th minute. Whilst in this condition, at the 95th minute, eserine was applied and caused a contraction of the pupil, which began at the 100th minute, and reached its maximum (4 mm.) at the 125th minute.

(2.) A recession of the near point, which began at the 5th minute, and reached its maximum at the 70th, being then equivalent to 3·75 D. At the 95th minute, when the recession was still great, eserine was applied, and caused an approximation, which began at the 100th minute, and reached its maximum at the 120th minute. The maximum approximation was equivalent to 3·69 D. The near point was therefore 2 cm. (0·89 D.) nearer to the eye than at first.

(3.) A variability in the position of the far point. The maximum recession occurred at the 75th minute, and was equivalent to 0·22 D. The maximum approximation

occurred at the 10th minute, and was equivalent to 0·2 D. At the 95th minute eserine was applied, and caused an approximation, which began at the 100th minute, reached its maximum at the 115th minute, and was then equivalent to 3·78 D. The far point was therefore 63 cm. (3·57 D.) nearer to the eye than at first.

(4.) A diminution in the range of accommodation, which began at the 5th minute, and reached its maximum at the 70th minute. This decrease at its maximum was equivalent to 3·61 D.; that is, 0·71 D. of the normal range (5·06 D.), so that the total range was then 1·45 D. At the 95th minute, when the range was still greatly diminished, (by 2·61 D.), eserine was applied, and caused a temporary diminution of the range, which was at its maximum at the 125th minute.

Case III.—C. P., æt. 21. *Right Eye.* A +2 D. Spherical Lens worn during the Observation.

Time.	Pupil.	Near point.	Far point.
Before application.....	3·5 mm.	11 cm.	114 cm.
After application—			
5 minutes	4 „	11 „	95 „
10 „	4·5 „	12 „	99 „
15 „	6·5 „	13 „	105 „
20 „	8 „	17 „	127 „
25 „	8 „	22 „	112 „
30 „	8·5 „	25 „	120 „
35 „	8·5 „	31 „	127 „
40 „	8·5 „	37 „	132 „
45 „	8·5 „	37 „	133 „
50 „	8·5 „	37 „	133 „
55 „	8·5 „	39 „	133 „
60 „ (eserine applied)	8·5 „	34 „	133 „
65 „	8·5 „	23 „	103 „
70 „	8·5 „	14 „	70 „
75 „	7 „	12 „	41 „
80 „	5 „	12 „	18 „
85 „	3 „	11 „	63 „
90 „	3·5 „	10 „	81 „
95 „	3·5 „	11 „	103 „
100 „	3 „	10 „	103 „
105 „	2·5 „	10 „	114 „
110 „	2·75 „	10 „	133 „
120 „	3 „	10 „	133 „
130 „	3 „	10 „	133 „

In this case the application of homatropine caused—

(1.) A dilatation of the pupil (3·5 mm.), which began at the 5th minute, and reached its maximum at the 30th minute. Whilst in this condition, at the 60th minute, eserine was applied, and caused a contraction of the pupil, which began at the 75th minute, and reached its maximum (2·5 mm.) at the 105th minute.

(2.) A recession of the near point, which began at the 10th minute, and reached its maximum at the 55th minute, being then equivalent to 6·53 D. At the 60th minute, when the recession was still great, eserine was applied, and caused an approximation, which began at the 65th minute, and reached its maximum at the 90th minute. The maximum approximation was equivalent to 7·06 D.; the near point was therefore 1 cm. (1·09) nearer to the eye than at first.

(3.) A variability in the position of the far point. The maximum recession occurred at the 45th minute, and was equivalent to 0·12 D. The maximum approximation occurred at the 5th minute, and was equivalent to 0·18 D. At the 60th minute eserine was applied, and caused an approximation, which began at the 65th minute, reached its maximum at the 80th minute, and was then equivalent to 4·75 D. The far point was therefore 96 cm. (4·68 D.) nearer to the eye than at first.

(4.) A diminution of the range of accommodation, which began at the 5th minute, and reached its maximum at the 55th minute. This decrease at its maximum was equivalent to 6·41 D., that is, 0·78 of the normal range (8·22 D.), so that the total range was then 1·81 D. At the 60th minute, when the range was still greatly decreased (by 6·03 D.), eserine was applied, and caused an increase of the range of accommodation, which was at its maximum at the 110th minute, when the total range was 9·25 D.

Case IV.—D., æt. 23. *Right Eye.* A +1 D. Spherical Lens worn during the Observation.

Time.	Pupil.	Near point.	Far point.
Before application.....	3 mm.	13 cm.	50 cm.
After application—			
5 minutes	3 „	13 „	50 „
10 „	3 „	15 „	50 „
15 „	3·5 „	16 „	50 „
20 „	3·75 „	14 „	46 „
25 „	5 „	17 „	48 „
30 „	6·5 „	22 „	47 „
35 „	7 „	20 „	48 „
40 „	8 „	23 „	46 „
45 „	9 „	23 „	48 „
50 „	9 „	25 „	47 „
55 „	9 „	28 „	48 „
60 „	9 „	26 „	43 „
65 „	9 „	29 „	43 „
70 „	9 „	29 „	43 „
75 „	9 „	29 „	50 „
80 „ (eserine applied)	9 „	28 „	43 „
85 „	9 „	19 „	35 „
90 „	9 „	17 „	27 „
95 „	8 „	14 „	18 „
100 „	3·5 „	13 „	18 „
105 „	2·5 „	13 „	22 „
110 „	2·5 „	12 „	31 „
115 „	2 „	14 „	29 „
120 „	2 „	11 „	30 „
125 „	2 „	12 „	28 „
130 „	2 „	12 „	41 „
135 „	2 „	13 „	40 „
140 „	2 „	14 „	

In this case the application of homatropine caused—

(1.) A dilatation of the pupil (3 mm.), which began at the 15th minute, and reached its maximum at the 45th minute. Whilst in this condition, at the 80th minute, eserine was applied, and caused a contraction of the pupil, which began at the 95th minute, and reached its maximum (2 mm.) at the 15th minute.

(2.) A recession of the near point, which began at the 10th minute, reached its maximum at the 65th minute, and was then equivalent to 4·24 D. At the 80th minute, when the recession was still great, eserine was applied,

and caused an approximation, which began at the 85th minute, and reached its maximum at the 120th minute. The maximum approximation was equivalent to 5·52 D.; the near point was therefore 2 cm. (1·4 D.) nearer to the eye than at first.

(3.) An approximation of the far point, which began at the 20th minute, reached its maximum at the 60th minute, and was then equivalent to 0·32 D. At the 80th minute, when it was much receded, eserine was applied, and caused an approximation, which began at the 85th minute, and reached its maximum at the 95th minute; it was then equivalent to 3·23 D. The far point was therefore 32 cm. (3·55 D.) nearer to the eye than at first.

(4.) A diminution in the range of accommodation, which began at the 10th minute, and reached its maximum at the 65th minute. This decrease at its maximum was equivalent to 4·65 D., that is, 0·8 of the normal range (5·69 D.), so that the total range was then 1·13 D. At the 80th minute, when the range was still greatly diminished (by 4·44 D.), eserine was applied, and caused an increase of the range of accommodation, which reached its maximum at the 130th minute, when the range was 5·89 D.

Summary.—It seems that the application of homatropine caused—

(1.) A dilatation of the pupil, which began between the 5th and 20th minutes, and reached its maximum between the 30th and 95th minutes. Eserine was applied between the 60th and 95th minutes, and caused a contraction of the pupil, which began between the 5th and 15th minutes and reached its maximum between the 25th and 45th minutes.

(2.) A recession of the near point, which began between the 5th and 10th minutes, reached its maximum between the 55th and 70th minutes, and was then equivalent to from 3·75 D. to 6·53 D. Eserine was applied between the 60th and 95th minutes, and caused an approximation, which began at the 5th minute, reached its maximum from the 20th to the 40th, and was equivalent to from 3·69 D.

to 7·78 D., so that the near point was from 1–4 cm. (0·89 to 3·42 D) nearer to the eye than at first.

(3.) A variability in the position of the far point. The maximum approximation occurred between the 5th and 45th minutes, and was equivalent to from 0·18 D. to 0·32 D. The maximum recession occurred between the 45th and 75th minutes, and was equivalent to from 0·12 D. to 0·6 D. Eserine was applied between the 60th and 95th minute, and caused an approximation, which began at the 5th minute, reached its maximum between the 15th and 20th minutes, and was then equivalent to from 3·23 D. to 7·2 D., so that the far point was from 31 cm. to 96 cm. (3·55 D. to 6·71 D.) nearer to the eye than in the normal state.

(4.) A diminution of the range of accommodation, which began between the 5th and the 10th minute, reached its maximum between the 55th and 70th minutes, and was then equivalent to from 3·61 D. to 6·14 D., that is, 0·71 to 0·8 of the normal range (5·06 D. to 8·22 D.), so that the total range was then from 1·08 D. to 1·81 D. Eserine was applied between the 60th and 95th minutes, and caused sometimes a temporary increase, and sometimes a temporary decrease of the range of accommodation.

Taking the average, it seems that the application caused—

(1.) A dilatation of the pupil (3·37 mm.), which began at the 12·5 minute, and reached its maximum at the 52·5 minute. Eserine was applied at the 78·75 minute, and caused a contraction, which began at the 11·25 minute (2·62 mm.), and reached its maximum at the 33·75 minute.

(2.) A recession of the near point, which began at the 8·75 minute, reached its maximum at the 63·75 minute, and was then equivalent to 4·84 D. Eserine was applied at the 78·75 minute, and caused an approximation, which began at the 5th minute, reached its maximum at the 28·75 minute, and was then equivalent to 6·01 D., so that the near point was 2·25 cm. (1·7 D.) nearer to the eye than it was in the normal condition.

(3.) A variability in the position of the far point. The maximum approximation occurred at the 25th minute, and was equivalent to 0·23 D. The maximum recession occurred at the 61·67 minute, and was equivalent to 0·31 D. Eserine was applied at the 78·75 minute, and caused an approximation, which began at the 5th minute, reached its maximum at the 18·75 minute, and was then equivalent to 4·74 D., so that the far point was 55·5 cm. (4·63 D.) nearer to the eye than it was in the normal state.

(4.) A diminution of the range of accommodation, which began at the 6·25 minute, reached its maximum at the 63·75 minute, and was then equivalent to 4·63 D., that is, 0·76 of the normal range (6·07 D.), so that the total range was then 1·37 D. Eserine was applied at the 78·75 minute, and caused sometimes a temporary increase, and sometimes a temporary decrease of the range. (*See* Chart III.)

IV. *The Action of Homatropine + Cocaine and Eserine.*

Case I.—A., æt. 23. *Left Eye.* V. $= \frac{6}{6}$ Hm. 0·5 D. A +2 D.

Spherical Lens was worn during the Observation.

Time.	Pupil.	Near point.	Far point.
Before application.....	3 mm.	13 cm.	105 cm.
After application—			
5 minutes	3 ,,	14 ,,	101 ,,
10 ,, ...	3·5 ,,	16 ,,	78 ,,
15 ,, ...	4·5 ,,	18 ,,	81 ,,
20 ,, ...	5 ,,	20 ,,	84 ,,
25 ,, ...	5·5 ,,	26 ,,	81 ,,
30 ,, ...	6 ,,	31 ,,	87 ,,
35 ,, ...	6·5 ,,	35 ,,	91 ,,
40 ,, ...	7 ,,	38 ,,	87 ,,
45 ,, ...	7·5 ,,	38 ,,	84 ,,
50 ,, ...	7·5 ,,	38 ,,	98 ,,
55 ,, ...	7·5 ,,	43 ,,	93 ,,
60 ,, ...	7·5 ,,	39 ,,	95 ,,
65 ,, ...	7·5 ,,	37 ,,	92 ,,
70 ,, ...	7·5 ,,	36 ,,	94 ,,
75 ,, ...	8 ,,	39 ,,	97 ,,
80 ,, ...	7·5 ,,	36 ,,	97 ,,

CASE I—*continued.*

Time.	Pupil.	Near point.	Far point.
85 minutes	..	37 cm.	96 cm.
90 „	9 mm.	34 „	97 „
95 „ (eserine applied)			
100 „	7·5 „	22 „	47 „
105 „	7·5 „	22 „	23 „
110 „	7·5 „	15 „	16 „
115 „	7·5 „	15 „	16 „
120 „	6 „	15 „	19 „
125 „	5 „	14 „	17 „
130 „	4·5 „	14 „	22 „
135 „	3·5 „	13 „	40 „
3·5 hours	normal	normal	

In this case the application of homatropine + cocaine caused—

(1.) A dilatation of the pupil (3 mm.), which began at the 10th minute, and reached its maximum at the 90th minute. Whilst in this condition, at the 95th minute, eserine was applied and caused a contraction of the pupil, which began at the 100th minute, and reached its maximum (3·5 mm.) at the 135th minute.

(2.) A recession of the near point, which began at the 5th minute, reached its maximum at the 55th minute, and was then equivalent to 5·37 D. At the 95th minute, when the recession was still great, eserine was applied and caused an approximation, which began at the 100th minute, and reached its maximum at the 135th minute. The maximum approximation was equivalent to 4·75 D. The near point was therefore not nearer to the eye than at first.

(3.) An approximation of the far point, which began at the 5th minute, reached its maximum at the 100th minute, and was then equivalent to 0·33 D. At the 95th minute, when it was somewhat approximated, eserine was applied and caused an approximation, which began at the 100th minute, and reached its maximum at the 110th,

being then equivalent to 5·22 D. The far point was therefore 89 cm. (5·3 D.) nearer to the eye than at first.

(4.) A diminution in the range of accommodation, which began at the 5th minute, and reached its maximum at the 55th minute. This decrease at its maximum was equivalent to 5·49 D., that is 0·81 D. of the normal range (6·74 D.), so that the total range was then 1·25 D. At the 95th minute, when the range was still greatly decreased (by 4·83 D.), eserine was applied and caused a still further temporary diminution. The maximum diminution occurred at the 105th minute, when the total range was 0·19 D.

Case II.—P., æt. 21. *Left Eye.* V. $= \frac{6}{6}$. Emmetropic. A +2 D. Spherical Lens was worn during the Observation.

Time.	Pupil.	Near point.	Far point.
Before application	4 mm.	13 cm.	42 cm.
After application—			
5 minutes	4·5 „	13 „	44 „
10 „	8 „	15 „	48 „
15 „	10 „	18 „	47 „
20 „	10 „	22 „	45 „
25 „	10 „	29 „	50 „
30 „	10 „	34 „	49 „
35 „	10 „	35 „	52 „
40 „	10 „	42 „	51 „
45 „	10 „	47 „	64 „
50 „	10 „	46 „	61 „
55 „	10 „	47 „	67 „
60 „	10 „	50 „	63 „
65 „	10 „	51 „	68 „
70 „	10 „	48 „	65 „
75 „	10 „	46 „	68 „
80 „ (eserine applied)	10 „	43 „	67 „
85 „	9·5 „	13 „	14 „
90 „	9 „	12 „	12 „
95 „	7 „	11 „	
100 „	5·5 „	11 „	
105 „	4·5 „	10 „	
110 „	3·5 „	10 „	
115 „	3 „	11 „	
120 „	3 „	11 „	
125 „	2·5 „	11 „	
130 „	2·5 „	11 „	
20 hours	normal		

In this case the application of homatropine + cocaine caused—

(1.) A dilatation of the pupil (4 mm.), which began at the 5th minute, and reached its maximum at the 15th minute. Whilst in this condition, at the 80th minute, eserine was applied and caused a contraction of the pupil, which began at the 85th minute, and reached its maximum (2·5 mm.) at the 125th minute.

(2.) A recession of the near point, which began at the 10th minute, and reached its maximum at the 65th minute, and was then equivalent to 5·73 D. At the 80th minute, when the recession was still great, eserine was applied and caused an approximation, which began at the 85th minute, and reached its maximum at the 105th minute. The maximum approximation was equivalent to 7·68 D. The near point was therefore 3 cm. (2·31 D.) nearer to the eye than at first.

(3.) A recession of the far point, which began at the 5th minute, reached its maximum at the 65th minute, and was then equivalent to 0·91 D. At the 80th minute, when it was much receded, eserine was applied and caused an approximation, which began at the 85th minute, reached its maximum at the 90th minute, and was then equivalent to 6·84 D. The far point was therefore 30 cm. (5·95 D.) nearer to the eye than at first.

(4.) A diminution of the range of accommodation, which began at the 10th minute, and reached its maximum at the 60th minute. This decrease at its maximum was equivalent to 4·9 D., that is, 0·92 of the normal range (5·31 D), so that the total range was then 0·41 D. At the 80th minute, when the range was still greatly decreased (by 4·48 D.), eserine was applied and caused a still further temporary diminution. At the 90th minute the range was *nil*.

Case III.—C. P., æt. 19. *Left Eye.* V. $= \frac{6}{6}$. Hm. 1 D. A +1·75 D. Spherical Lens was worn during the Observation.

Time.	Pupil.	Near point.	Far point.
Before application	3·5 mm.	11 cm.	125 cm.
After application—			
5 minutes	4 „	12 „	97 „
10 „	6 „	13 „	93 „
15 „	8 „	21 „	98 „
20 „	9·5 „	39 „	
25 „	10 „	42 „	
30 „	10 „	56 „	
35 „	10 „	68 „	
40 „	10 „	60 „	105 „
45 „	10 „	65 „	101 „
50 „ (eserine applied) ..	10 „	65 „	92 „
55 „	9·5 „	35 „	110 „
60 „	9·5 „	19 „	62 „
65 „	9·5 „	12 „	21 „
70 „	8 „	12 „	67 „
75 „	5·5 „	12 „	90 „
80 „	6·5 „	12 „	90 „
85 „	5 „	11 „	90 „
90 „	6·5 „	12 „	133 „
95 „	6·5 „	11 „	133 „
100 „	5·5 „	12 „	133 „
105 „	4·5 „	12 „	133 „
110 „	5 „	11 „	133 „
120 „	5·5 „	13 „	133 „
130 „	5·5 „	13 „	133 „

In this case the application of homatropine + cocaine caused—

(1.) A dilatation of the pupil (5·5 mm.), which began at the 5th minute, and reached its maximum at the 25th minute. Whilst in this condition, at the 50th minute, eserine was applied and caused a contraction of the pupil, which began at the 55th minute, and reached its maximum (4·5 mm.) at the 105th minute.

(2.) A recession of the near point, which began at the 5th minute, reached its maximum at the 35th minute, and was then equivalent to 7·62 D. At the 50th minute, when the recession was still great, eserine was applied and caused an approximation, which began at the 55th

minute, and reached its maximum at the 85th minute. The maximum approximation was equivalent to 7·55 D. The near point was therefore not nearer to the eye than at first.

(3.) An approximation of the far point, which began at the 5th minute, reached its maximum at the 50th minute, and was then equivalent to 0·29 D. At the 50th minute eserine was applied and caused an approximation, which began at the 60th minute, and reached its maximum at the 65th, being then equivalent to 3·67 D. The far point was therefore 104 cm. (3·96 D.) nearer to the eye than at first.

(4.) A diminution of the range of accommodation, which began at the 5th minute, and reached its maximum at the 50th minute. This decrease at its maximum was equivalent to 7·84 D., that is, 0·94 of the normal range (8·29 D.), so that the total range was then 0·45 D. At the 50th minute, when the range was greatly decreased (by 7·84 D.), eserine was applied and caused an increase of the range of accommodation. The maximum increase occurred at the 95th minute, when the total range was 8·34 D.

Case IV.—D., æt. 23. *Left Eye.* A +1 D. Spherical Lens worn during the Observation.

Time.	Pupil.	Near point.	Far point.
Before application	3 mm.	12 cm.	56 cm.
After application—			
5 minutes	3 ,,	12 ,,	67 ,,
10 ,,	3 ,,	14 ,,	58 ,,
15 ,,	3·5 ,,	17 ,,	54 ,,
20 ,,	3·75 ,,	20 ,,	56 ,,
25 ,,	5·5 ,,	20 ,,	51 ,,
30 ,,	Oval 8 ,, 6·5 mm.	20 ,,	49 ,,
35 ,,	9 ,, 8 ,,	25 ,,	53 ,,
40 ,,	9 ,,	29 ,,	53 ,,
45 ,,	10 ,,	30 ,,	52 ,,
50 ,,	10 ,,	34 ,,	52 ,,
55 ,,	10 ,,	34 ,,	50 ,,
60 ,,	10 ,,	35 ,,	50 ,,

CASE IV—*continued.*

Time.	Pupil.	Near point.	Far point.
After application—			
65 minutes	10 mm.	36 cm.	46 cm.
70 „	10 „	34 „	52 „
75 „	10 „	38 „	55 „
80 „ (eserine applied)	10 „	32 „	51 „
85 „	10 „	22 „	38 „
90 „	10 „	18 „	25 „
95 „	9 „	14 „	16 „
100 „	5 „	14 „	19 „
105 „	3 „	13 „	19 „
110 „	2·75 „	13 „	32 „
115 „	2 „	15 „	31 „
120 „	2 „	13 „	43 „
125 „	2 „	12 „	41 „
130 „	2 „	14 „	45 „
135 „	2 „	13 „	46 „
140 „	2 „	13 „	43 „

In this case the application of homatropine + cocaine caused—

(1.) A dilatation of the pupil (3 mm.), which began at the 15th minute, and reached its maximum at the 45th minute. Whilst in this condition, at the 80th minute, eserine was applied and caused a contraction of the pupil, which began at the 95th minute, and reached its maximum (2 mm.) at the 115th minute.

(2.) A recession of the near point, which began at the 10th minute, reached its maximum at the 75th minute, and was then equivalent to 5·76 D. At the 80th minute, when the recession was still great, eserine was applied and caused an approximation, which began at the 85th minute, and reached its maximum at the 125th minute. The maximum approximation was equivalent to 5·21 D. The near point was therefore nearer to the eye than at first.

(3.) A variability in the position of the far point. The maximum approximation occurred at the 65th minute, and was equivalent to 0·39 D. The maximum recession occurred at the 5th minute, and was then equivalent to 0·29 D. At the 80th minute eserine was applied and

caused an approximation, which began at the 85th minute, reached its maximum at the 95th, and was then equivalent to 4·29 D. The far point was therefore 40 cm. (4·47 D.) nearer to the eye than at first.

(4.) A diminution in the range of accommodation, which began at the 10th minute, and reached its maximum at the 65th minute. This decrease at its maximum was equivalent to 5·94 D., that is, 0·91 of the normal range (6·55 D.), so that the total range was then 0·61 D. At the 80th minute, when the range was still greatly decreased (by 5·39 D.), eserine was applied and caused some increase of the range.

Summary.—It seems that the application of homatropine + cocaine caused—

(1.) A dilatation of the pupil (3 to 4 mm.), which began between the 5th and 15th minutes, and reached its maximum between the 15th and 90th minutes. The application of eserine between the 50th and 95th minutes caused a contraction of the pupil, which began in 5 to 15 minutes, and reached its maximum (2 to 4·5 mm.) in from 35 to 55 minutes.

(2.) A recession of the near point, which began between the 5th and 10th minutes, reached its maximum between the 35th and 75th minutes, and was then equivalent to from 5·37 D. to 7·62 D. The application of eserine between the 50th and 95th minutes caused an approximation, which began in 5 minutes, reached its maximum in 25 to 40 minutes, and was then equivalent to from 4·57 D. to 7·68 D., so that the near point was in the same situation or nearer than before the application of cocaine and homatropine.

(3.) A variability in the position of the far point. The maximum approximation occurred between the 10th and 65th minutes, and was equivalent to from 0·29 D. to 0·39 D. The maximum recession occurred between the 5th and 65th minutes, and was equivalent to from 0·29 D. to 0·91 D. The application of eserine between the 50th

and 95th minutes caused an approximation, which began between the 5th and 10th minutes, reached its maximum between the 10th and 15th minutes, and was then equivalent to from 3·67 D. to 6·84 D., so that the far point was from 30 cm. (5·95 D.) to 104 cm. (3·96 D.) nearer to the eye than before the application of homatropine and cocaine.

(4.) A diminution of the range of accommodation, which began between the 5th and 10th minutes, reached its maximum between the 50th and 60th minutes, and was then equivalent to from 4·9 D. to 7·84 D., that is, 0·81 to 0·94 of the normal range (5·31 D. to 8·29 D.), so that the total range was then 0·41 D. to 1·25 D. The application of eserine between the 50th and 95th minutes sometimes caused a further temporary diminution, and sometimes a temporary increase of the range.

Taking averages, it seems that this application caused—

(1.) A contraction of the pupil (3·37 mm.), which began at the 8·75 minute, and reached its maximum at the 43·75 minute. Eserine was applied at the 76·25 minute, and caused a contraction of the pupil, which began at the 7·5 minute, and reached its maximum (3·12 mm.) at the 43·75 minute.

(2.) A recession of the near point, which began at the 7·5 minute, reached its maximum at the 57·5 minute, and was then equivalent to 6·12 D. Eserine was applied at the 76·25 minute and caused an approximation, which began at the 5th minute, reached its maximum at the 32·5 minute, and was then equivalent to 6·14 D., so that the near point was 0·75 cm. (0·58 D.) nearer to the eye than at first.

(3.) A variability in the position of the far point. The maximum approximation occurred at the 41·67 minute, and was equivalent to 0·34 D. The maximum recession occurred at the 65th minute, and was equivalent to 0·6 D. Eserine was applied at the 76·25 minute and caused an

approximation, which began at the 6·25 minute, reached its maximum at the 13·75 minute, and was equivalent to 5 D., so that the far point was 65·75 cm. (4·92 D.) nearer to the eye than at first.

(4.) A diminution of the range of accommodation, which began at the 7·5 minute, and reached its maximum at the 57·5 minute. The maximum diminution was equivalent to 6·04 D., that is, 0·89 of the normal range (6·72 D.), so that the total range was then 0·68 D. Eserine was applied at the 76·25 minute, and sometimes caused a temporary increase, and sometimes a temporary decrease of the range. (*See* Chart 4.)

Practical Deduction.—After paralysis of the sphincter pupillæ and ciliary muscle has been effected by the application of homatropine, or of homatropine + cocaine, the application of eserine causes a contraction of the pupil, and an approximation of the near point to such an extent that in the great majority of cases the individual can in a few minutes resume work of all kinds without inconvenience.

Table showing the Action (average) of Eserine, Pilocarpine, Homatropine, and Homatropine + Cocaine.

		Pupil.		Movement of near point.		Movement of far point.		Alteration of range of accommodation.	
		Contraction.	Dilatation.	Approximation.	Recession.	Approximation.	Recession.	Increase.	Diminution.
Time of commencement of action.	Eserine.....	7·27 min.	..	4·73 min.	..	6·58 min.			
	Pilocarpine ..	13·75 „	..	13·33 „	..	15 „	..	11·25 min.	
	Homatropine.	..	13·33 min.	..	6·67 min.	..	..	..	5 min.
	Homatropine + cocaine	..	10 „	..	6·67 „	..	..	..	5·83 min.
Time of maximum action.	Eserine	17·33 min.	..	23·8 min.	..	18·14 min.	..	52·22 min.	
	Pilocarpine ..	22·5 „	..	28·33 „	..	26·67 „	..	60·9 „	22·5 min.
	Homatropine.	..	60 min.	..	61·67 min.	53·33 „	63·33 min.	..	65 „
	Homatropine + cocaine	..	30 „	..	61·67 „	50 „	77 „	..	59·17 „
Time of cessation of action.	Eserine	24-48 hrs.	..	8 hours	..	55·22 min.	..	8 hours	
	Pilocarpine ..	48 hrs.	..	70 min.	..	60·83 „	..	70 min.	
	Homatropine.	..	21·67 hrs.	..	8·75 hrs.	..	..	..	8·75 hours.
	Homatropine + cocaine	..	34·5 „	..	25·67 „	..	..	..	25·67 „

		Pupil.		Movement of near point.		Movement of far point.		Alteration of range of accommodation.	
		Contraction.	Dilatation.	Approximation.	Recession.	Approximation.	Recession.	Increase.	Diminution.
Amount of maximum action.	Eserine	..	..	9·89 D.	..	4·54 D.	..	8·24 D, *i.e.*, 1·319 of normal range 6·20 D.	1·68 D., *i.e.*, 0·26 of normal range.
	Pilocarpine ..	..	..	3·51 D.	..	2·7 D.	..	2·72 D., *i.e.*, 0·36 of normal range 7·84 D.	2·96 D.
	Homatropine.	..	..	..	6·33 D.	0·42 D.	0·78 D.	..	6·12 D., *i.e.*, 0·86 of normal range 7·14 D.
	Homatropine + cocaine	..	..	..	6·97 D.	0·43 D.	0·75 D.	..	6·58 D., *i.e.*, 0·91 of normal range 7·23 D.

Chart 1. Average action of Homatropine.

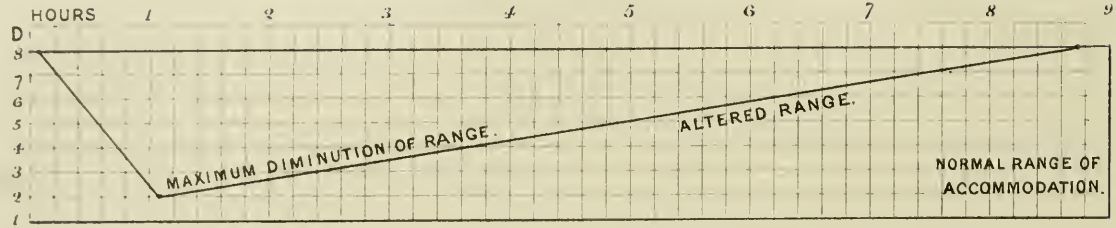


Chart 2. Average action of Homatropine with Cocaine.

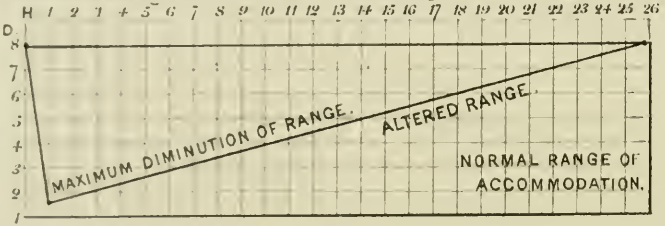


Chart 3. Average action of Homatropine with Eserine.

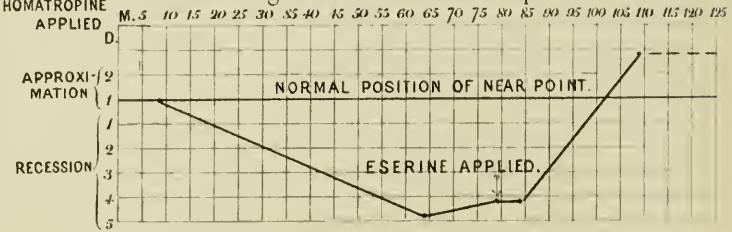
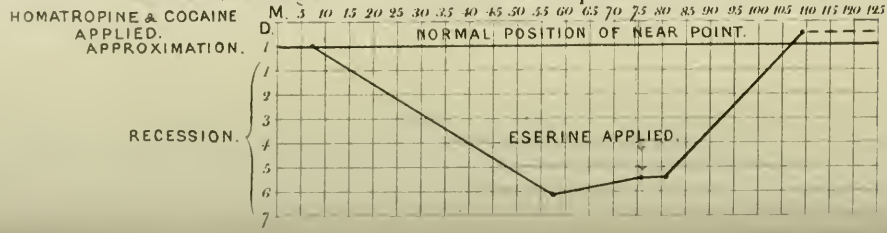


Chart 4. Average action of Homatropine with Cocaine and Eserine.



Literature.

We append a list of the essays which have appeared on this subject of the action of homatropine, and to which we have been able to obtain access. No previous observer appears to have worked in the same manner, so that any quotations for purposes of comparison would be useless. On the subject of the action of homatropine and cocaine so far as we are aware there has been no publication.

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(2.) Pantynski. Pilocarpin und Homatropin. Klin. Monatsblätt. für Augenh. 1880. S. 343.

(3.) Fronmüller. Das Bromwasserstoffsäure Homatropin. Memorab. 7. S. 298. 1880.

(4.) Bertheau. Das Homatropin. Berlin Klin. Wochens. Nr. 41. 1880.

(5.) Schell, H. S. A New Mydriatic. Additional Note. Philadelphia Med. Times, XI, pp. 7 and 47. 1880.

(6.) Risley, S. D. Comparative Value of the Mydriatics. Transactions American Ophthalm. Soc. 1881. P. 228.

(7.) Risley, S. D. The Value of Homatropine Hydrobromate in Ophthalmic Practice. American Jour. Med. Science. 11, 161. 1881.

(8.) Schäfer, H. Comparative Investigations into the Effects upon the Eye of Atropine, Duboisine, and Homatropine. Knapp's Archives of Ophthalmology. Vol. X, p. 196. 1881.

(9.) Little. Homatropine Hydrobromate. Is it a Powerful Mydriatic? Philadelphia Med. Times, Feb. 26th, 1881.

(10.) Oliver. Comparative Action of Homatropine and of Sulphate of Atropia upon the Iris and Ciliary Muscle. American Jour. Med. Science, July, p. 150. 1881.

(11.) Schirmer. Homatropin. Lex. Art. Real-Encyclop. Bd. VI. 1881.

(12.) Sedan. Emploie de l'Homatropine en Oculistique. Gaz. Hébdom., 18, S. 494. 1881.

(13.) Krosta. Ueber Homatropinum Hydrobromatum Sitzungsberichte der Gesell. der Charité Aertze, von 23 Dezemb. 1880. Berlin Klin. Wochensch. 1881. N. 6.

MISCELLANEOUS CASES.

By E. Nettleship.

(Continued from page 77.)

Mydriasis without Cycloplegia, affecting one Eye of a Man in an early stage of Locomotor Ataxy.

William W., labourer, æt. 35 (T. 5, p. 60), was brought by Mr. Clutton from his out-patient room, on December 31st, 1886. He was under Mr. Clutton's care for painless effusion into the right knee, of a year's duration, with considerable relaxation of ligaments and free lateral movement with some grating. Knee-reflexes absent, liable to sharp sudden "shocking" pains in the thighs and legs, especially at change of weather; they last a few hours, and then pass off, perhaps for weeks. Some incontinence of urine at night. Gait and sexual functions not altered. Vision and accommodation equal and perfect in each eye (p. p. being at 22 to 25 cm. in each eye with Hm. 0·5 D.) but the pupils were not alike. The right pupil acted well to light and accommodation, and measured from 3 to 4 mm., dilating to about 5 under 2 per cent. cocaine, and contracting to rather less than 2 under eserine; the left measured 5·5 mm., and was quite motionless both to light and to accommodation, it dilated to 8·5, three-quarters of an hour after cocaine 2 per cent. had been used, and in this state contracted very slowly to 5 or 6 mm. when strongly lighted, eserine 1 per cent. contracted it to rather less than 2 mm. in half an hour.

There is no history of injury to either eye; the patient probably had syphilis 12 years ago. His son, aged 12, is now under Dr. Brailey's care in Guy's Hospital, with severe interstitial keratitis.

Wide Mydriasis of both Eyes, for 15 years, with only slight Cycloplegia. Locomotor Ataxy.

Mr. K., æt. 47, was sent by Dr. Hughlings Jackson, in 1881 (P. 5, 18). The refraction was natural and acuteness of vision

nearly normal in each eye. With each he could read 4 J. or 6 J. up to 33 cm., but preferred a distance of 40 cm., and required +3 D. for reading 1 J. at 22 cm. At his age, with emmetropic refraction, he should according to rule have required only + 1·5 D. for reading at 22 cm. We may conclude, therefore, that his Acc. was relatively defective to the extent of 1·5 D. but not more. The pupils were very large and quite motionless both to light and accommodation: on February 9th, the R. is noted as 7·5 mm., the L. 8 mm; on March 16th the R. 8 mm., the L. 9 mm. Both pupils contracted well to eserine. In the L. there was old choroidal disturbance about the y.s., and in both the o. d. was rather pale and hazy; there had probably been some choroido-retinitis when he had syphilis 22 years before.

Mr. K. was under Dr. Jackson's care for well-marked locomotor ataxy with severe gastric attacks. It seemed likely that dilatation of the pupils had been one of the earliest symptoms of the disease, for he said that 15 years before I saw him a doctor had told him that the pupils were too large, and 7 years later Mr. Critchett said they were extremely large. He believed that they had previously been of ordinary size, not particularly small. That the ciliary muscle never suffered in proportion was proved by the power of the glasses he was wearing; but that it had suffered in some degree was shown by his having taken to weak spectacles at the age of 35, about 3 years after the mydriasis was first noticed, and 12 years before I saw him.

For the last 2 or 3 years there had been diplopia, due, as examination showed, to paresis (varying in degree) of the L. inferior oblique.

Mydriasis without Cycloplegia affecting one Eye and coming on several years after a severe Abdominal Illness following Injury. Knee-reflexes absent.

Miss Florence P. (P. 9, p. 44), a quick, bright child, æt. 11, florid and well grown, was seen in consultation with Dr. Clapton, on January 2nd, 1884, on account of the peculiarity of her left pupil. The left pupil was more than twice as wide as the right, measuring 6·5 mm., and almost motionless;

when very brightly lighted it slowly contracted a little, but was never less that 5·5. She saw $\frac{6}{6}$ with this eye and read 1 J. easily up to about 8 cm.; Hm. 0·75. The other (right) eye was natural in all respects, the pupil, about 3 mm., acting perfectly; no Hm.; fundus normal in each. The palpebral fissure was of equal width on the two sides. The inequality of the pupils had been noticed for some months, but not so much as 12 months, and no cause had been assigned, but it seemed possible that the condition was connected with the illness about to be mentioned. She had never had fits. The family history was good except that the eldest child (a girl) died of phthisis.

When the patient was 5 she was run over by a four-wheeled fly; she was rolled over and over and the wheel passed over her twice, going over the upper part of the abdomen; there was no injury to the head. She was seen by Dr. Clapton, Dr. Acland, and others, and rupture of liver was at first suspected. For the first three weeks she was weak, but no severe symptoms seem to have occurred. Then her belly swelled very much, she was in great pain and became extremely ill; she was ill from May until October, and became extremely thin, like skin and bone. The belly remained too big for 18 months, but eventually she got perfectly well; no blood or pus was ever passed. Though no precise diagnosis was arrived at and different views were taken of the connection between this illness and the accident, there is no doubt that she was for some time in great danger. Tubercular disease of mesenteric glands was suspected for a time.

I saw her again a year later, January, 1885, the left pupil was in exactly the same state, if anything a little larger, accommodation was still perfect, there being no decided difference in the distance of the near point in the two eyes; the other pupil was, as before, natural. The left (dilated) pupil contracted to pin's-head size after a drop of eserine ($\frac{1}{8}$ per cent.) had been applied, and next morning measured 5 mm. On testing the knee-reflexes no jerk could be obtained on either side after repeated trials. There were no symptoms of abdominal tumour of any kind, and no signs of inherited syphilis.

She was a neurotic child, sleeping badly if at all out of health, and having a peculiar habit of shaking her head quickly when out of doors. She had lately had some "growing pains"

in left leg. She had been complaining lately of seeing patterns and violet and yellow spots before her eyes, especially in the morning.

She came again the following November (1885). She was growing well, had gained flesh, was doing well at school, and had partly got over the shaking of her head. Knee-reflexes were still absent. The left pupil still much larger than the right, but contracting somewhat (from 7 to 5·5 mm.) during strong accommodation; the right pupil however contracting much more (from 6 to 3) under the same test. The left pupil dilated to 9 mm. under cocaine.

Mydriasis without Cycloplegia in one Eye only, of unknown duration. Suspicion of Old Vasomotor Paralysis on same side of Face.

Mr. R., æt. 56, was sent to me by Dr. Gowers in 1879 (P. 3, 66) for examination. He was intemperate, had had two attacks of paraplegia, and was subject to neuralgic pains and "pins and needles." Dr. Gowers considered his paralytic symptoms to be alcoholic. He had probably had syphilis (at least 20 years previously).

For years he had had acne rosacea of the left side of the face, but hardly any spots came on the right side; his right nostril had for a long time been drier than the left; he wore his hat down on the right side, "because the right side of my head is too small," and the right side of the face was rather less mobile than the left during ordinary efforts, though in strong efforts both sides acted equally; he said that he sweated equally on the two sides. He was very deaf of both ears. Smell good.

The pupils were very unequal, the R. the larger; he could not say how long this had been the case, but professed to remember that in childhood he used to like to shut the R. eye, because it felt glaring light more than the L.

Condition of the Eyes.—R. V. $\frac{10}{30}$ badly, with −0·75 D. $\frac{10}{20}$ partly; reads 4 J. well up to 22 or 24 cm. without a glass. P. measures 7 mm. when looking at distant objects, and con-

tracts a little during Acc., but dilates again; slight opacity at posterior pole of lens, and a few patches of old choroiditis at extreme periphery of fundus. (Action of p. to atropine and eserine not tried.)

L. V. $\frac{10}{20}$ badly, rather improved by $-0{\cdot}75$ D.; reads 4 J. up to 22 or 24 cm. without a glass. P. 2·5 to 3 mm., when looking at distant object, contracting moderately during Acc.; interior of eye n., except a path of epithelial distance at y. s. After a drop of duboisine was put in, the p. became larger than the R. p. in its ordinary state.

The condition of the R. p. was the same a fortnight later, and was no doubt permanent.

My notes do not actually state that the reflex action of the pupils to light was tried; but the heading of the case, written at the time, implies that the R. one, at any rate, was inactive to this test.

Wide Mydriasis without Cycloplegia following a severe Blow on Eye.

John L., æt. 27 (Moorfields, 2, p. 1), came to Moorfields on November 11th, 1885, with the left pupil widely dilated (9 mm.), motionless to light and accommodation; V. $= \frac{6}{12}$, Hm. 1 D. $= \frac{6}{9}$, reads 1 J. p. p., 17 cm.; thus accommodation was perfect or all but so. After three applications of eserine (1 per cent.), the pupil contracted to 1·75 mm., and p. p. came to 7 cm. The other (right) saw $\frac{6}{6}$, had Hm. 0·5D. and 1 J. p. p. 17 cm.; pupil larger than usual, but active both to light and to accommodation. The fundus in each eye was healthy; there were some nebulæ on the left corneæ apparently old. Two months before he had a severe blow on the left eye from a stone thrown to meet him as he was driving in a cart; he felt faint, but was able to drive home a mile further on; the upper lid was cut. He was able to open the eye the same day, and found that he could see "nothing at all" with it. The next day he could just see the doctor standing by him; after this the

sight quickly improved, and for the past three weeks had been as good as on admission. Drops were used three or four times at first, but none for several weeks past; some lotion was also used, but was left off two weeks before he came to me. Except the history pointing to corneal ulcers many years before, there seems to have been nothing amiss with his eye until the accident.

Embolism or Thrombosis of Arteria Centralis Retinæ in R., followed by same in L. about 12 *days later. Sight retained in exactly symmetrical Sector of each Field; Chronic Renal Disease; Death* 2 *months after the Retinal Embolism.*

Mrs. B., æt. 36 (P. 8, 250), married several years; has had five children; the youngest living is 2 years old; the last pregnancy ended in a bad miscarriage at sixth month, in August, 1882, the child being decomposed. Some years ago, when living in Kent, had ague. No rheumatism or gout. No special reason to suspect syphilis. Was always "nervous," and liable to headaches. Owing to peculiarities of manner, to the history of melancholia in a sister, and to the fact that her husband is a publican, her medical attendant has at various times suspected intemperance, hysteria, and threatened mental disease. She had not been supposed to have either renal or cardiac disease, but she was dyspeptic, rather puffy, and often in the doctor's hands.

One day, on July 18th or 19th, 1883, she found all at once that she could not see properly with her R. eye; she could not see the lower parts of things. She believes it came on quite suddenly. I saw her, in consultation with Dr. Aveling, of Clapton, just a week later, on July 26th, and found the field of vision of the affected eye entirely absent, except on about one-fifth of its area at the upper and outer part, where a sector of sight remained; the lower boundary between blind and seeing part was sharply defined (as tested by the fingers), but the upper boundary seemed to be less defined (Fig. 1). Several of the retinal arteries were evidently obliterated, and represented by mere white lines, the veins rather tortuous, the disc hazy, and some hæmorrhages were present. No white patches seen. The other eye was perfect in every way. Though

the examination was made under difficulties at her home, the history, present symptoms, and appearances justified the diagnosis of either embolism or thrombosis of the arteria centralis

FIG. 2.

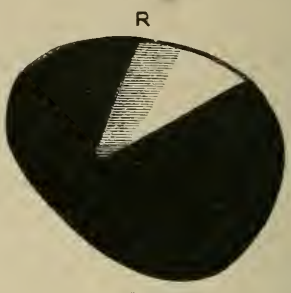


FIG. 1.

retinæ. She was a good deal frightened, and in a state of suppressed excitement, and as I could not say much about the hope of recovery of the affected eye, I said a good deal to her and her husband about the extreme improbability of the same thing happening to the other eye. After my visit the heart was again examined, and found to be hypertrophied, but without signs of valvular disease, and the urine found to be albuminous. During the night of August 1st, having occasion to get up and light the gas, she found that the sight of the other (L.) eye had gone in exactly the same way; between this date and the 9th, when I saw her again (at my house), the sight remained the same. At that date (August 9th) the field of the L. was in just the same state as that of the R. had been, the upper-out one-fourth or one-fifth alone remaining intact (Fig. 2). With each eye she could see 50 Sn. at 20′ by moving her eye about so as to catch the letters; T. n. in each. In the L. (second) eye I saw no obliterated arteries, but none of them pulsated upon pressure, and the trunk was therefore probably blocked; a few small vessels over inner edge of disc were enlarged and very tortuous, showing collateral circulation; one or two small hæmorrhages; numerous small spots of pigment surrounded by pale areas, on the choroid, chiefly at the periphery, such as might have been left by syphilitic choroiditis, or by a previous crop of scattered retinal hæmorrhages.

In the R. at this date the artery going down-in was con-

verted into a white line for a long distance, but I thought it showed a very narrow blood column; an extremely tortuous large vessel seen near to this obliterated artery was taken for its companion vein. A few spots of pigment disturbance at the periphery, but not nearly so many as in the L.; a few scattered recent round hæmorrhages. She looked very unwell, was soon tired, and complained of alternate chills and sweats, and of pains in head. The urine showed a considerable cloud of albumen; no sugar. No anasarca, no sickness.

On 20th the R. (first) eye seemed worse, seeing only 200 Sn. at 20′; the L., however, had much improved, seeing 30 Sn., and almost 20 Sn. at 20′, and reading words of 8 or 10 J.; sector of unimpaired vision in the field seemed (to finger test) decidedly larger than at the former examination.

The obliterated artery in the R. was unaltered, and in the L. a similar vessel was now noticed for the first time, though it had very likely been present at the former examination. A large and very tortuous vessel ran near to, though not alongside of, the obliterated artery in each eye. In the R. this was certainly an artery (because the companion vein of the obliterated artery was visible close to that vessel); it became *larger* towards the periphery, and at the extreme visible limit of the ophthalmoscopic field it seemed as if about to join the termination of the "obliterated" artery, which here was of full size, and had lost its white sheath (or thickened coat). In the L. this tortuous vessel, also an artery, was connected on the disc with a network of small tortuous vessels, evidently arterioles dilated for collateral circulation.

The presence of a single enlarged tortuous artery, evidently dilated in order to compensate, is extremely unusual in the retina. In the R. this artery corresponded roughly with the seeing area; in the L. I have not noted its position. The presence of this artery in each eye was probably due to some peculiarity in the origin or mode of branching of the arteria centralis, and probably accounted for the vision remaining in a part of each field.

Mrs. B. rapidly became worse in health, got very dyspeptic, suffered from feverish attacks (I understood with rise of temperature), and died about the end of September. No *post mortem* was allowed.

The questions in this case are:—

Why did the renal disease cause arterial plugging and not the ordinary albuminuric retinitis?

Why did no other arteries become plugged?

Was there anything peculiar about the renal disease?

Why did she retain intact an exactly symmetrical portion of each visual field?

Heart Disease; Attack of Severe Giddiness, Vomiting, and Prostration; Retinal Embolism three days later.

Mr. C. (P. 8, 117), æt. 27, tall, strong, very muscular, and fond of football and violent exercise. On April 28th, 1883, after some exertion, the details of which I have not noted, he became very giddy for several hours and vomited freely. Afterwards he felt much prostrated. On the evening of May 1st, when he got up to go to bed, he found that the upper half of the sight of his L. eye was obscured. He had been for a drive, facing the east wind the same afternoon.

I saw him on May 7th. He was still feeling rather giddy, and had an uncomfortable feeling in his head, referred to the L. parietal region. There was no deafness. Acuteness of sight was normal in each eye, but the upper part (almost the half) of the field of the L. was blind. There was dense white haze of the lower half of the retina (more properly the lower half of the yellow-spot region) of the character usual in embolism, with enlargement of the minute vessels. The retinal arteries, even those supplying the inflamed area, were of full size. Owing to the haze I could not feel sure whether the branches supplying the diseased area pulsated on pressure, but those going to the non-affected parts did pulsate easily. No hæmorrhages.

He had not had rheumatic fever, but Dr. Gowers found "considerable aortic disease and secondary mitral regurgitation."

What was the nature of his attack of giddiness and vomiting; and in what relation did it stand to the retinal embolism?

Repeated Attacks of Failure of Sight during several days in both Eyes, ending in almost complete Blindness with appearances of Retinal Vascular Blocking. Influence of Posture. Probably Thrombosis of both Retinal Arteries excited by feeble Circulation with diseased Vessels.

Geo. McDonald (I. P., T., 1884, No. 27), a wheelwright, æt. 78, was going for a walk on the evening of Jan. 29, 1884, when he "felt faint," all the gas-lights "turned blue," and he had to hold on to the railing; he got to a friend's house near, rested for half an hour, and then felt well and saw the lights clear and of the proper colour. Next morning (30th) at about 10 o'clock his sight became foggy, so that he "thought there was an eclipse," and gradually faded until he could not see the light of the fire in the grate; he then lay down in bed for a couple of hours, and on getting up could again see pretty well, but the sight got worse again towards night. For the next four or five days the sight varied, but on the whole got worse, until by Feb. 6th he was as blind as when he was brought to the hospital two days later (8th).

On admission (Feb. 8th).—He could see fingers badly at 6″ with the R. eye; p. $5\frac{1}{2}$ mm., and nearly motionless; ophth.,— slight, diffused haze of retina, o. d. rather pale, retinal vessels about normal in size, and pulsation easily produced in the arteries, no hæmorrhages. L. eye; no p. l.; p. $5\frac{1}{2}$ mm.; ophth.,— retina more hazy than in R. so that the fovea centralis was apparent as a red spot, retinal arteries of normal size, but neither pulsate nor empty on pressure, the upper main vein almost empty on o. d. but beyond o. d. full though too small, lower main vein shows a broken blood column the movements of which can be easily seen near the o. d.

He is a spare, sallow, wizened old man, feeble but intelligent. Arteries tortuous and their walls very hard; heart sounds and impulse feeble but no bruit; lungs emphysematous; urine free from albumen and sugar, sp. gr. 1027; he was formerly a heavy drinker, chiefly of beer, and never went a week without getting drunk. He has always been in the habit of going without food from breakfast till dinner at 4 o'clock, and he still does so; during the last 12 months he has several times come home feeling very faint apparently from want of food.

He was taken in and kept in bed, on his back, for about 10 days. V. in the R. improved a little during the first few days (on 10th V. of R. = fingers at 3′, and on 14th the same at 3′ to 4′), but after that remained stationary.

A few days after admission the veins in the L. regained their natural size and appearance.

On March 6th, the date of the last note, vision was about the same and he could see a letter or two of 20 J.; there was little, if any, haze of retina in either eye, the retinal vessels were of normal size, and the discs rather, but not very, pale.

Chronic Iritis with (?) Node in Cornea many years after Syphilitic Infection.

Anne S., æt. 54 (Moorfields, 2, 48), came to Moorfields in March, 1886, with subacute iritis in the right eye of a fortnight's duration; ciliary congestion, a single synechia, T.n. She attended regularly without marked change until September 8th, using atropine and taking a little iodide of potassium. At that date I noticed a round whitish deposit in the cornea, just below the centre and apparently in the deeper layers, 2 mm. wide; there were two other and less defined spots; the iris had become fleshy, and several lymphy synechiæ had formed. The patch was unlike anything that I recollected to have seen in the cornea, and thinking it might be a node we went carefully into the history. The patient had been married twice. By the first husband, who died 20 years ago of "consumption," there were eight children; 1st living, 2nd stillborn, 5 died between five and nine months, having had eruptions on hands, arms, and thighs; 1 was killed. By second husband, whom she married 18 years ago, four children, three are living, one died at 16 months of measles. She has had neither rheumatism or gout. Ten years ago she was under Mr. Wordsworth's care for double sight, and on his letter we found the diagnosis "paralysis of right external rectus." As it therefore seemed certain that she was syphilitic, she was ordered larger doses of iodide with small doses of blue pill and perchloride of mercury. On September 29 the corneal deposit was unaltered, and there were two buff-coloured deposits in the lower part of the angle between cornea and iris, as in bad cases of keratitis punctata, but no small dots could be made out

either now or at previous examinations: the treatment was continued, and upon November 10 the deposit in the cornea and those in the angle had entirely disappeared.

Single large Retinal Hæmorrhage from Retching. Much Pigment left around the Vessel implicated for more than a year. Subsequently complete Absorption of the Pigment.

Mr. S. (P. 4, p. 10) aged about 35, a medical man, on getting up one morning, about a year before I saw him, was very violently sick, and at once found a large blot in the lower part of the left field, so that when he looked straight forwards he could not see a cigar held at the left side of his mouth, the right eye being shut; the defect passed away in the course of three or four months. He came to me with asthenopia from over-drawing, &c., having suffered from it for two years, and the left eye being always the more troublesome; his circulation was excitable and his tone low.

When I saw him in Jan., 1880, I found in the L. eye the changes which are half diagrammatically represented in Fig. 1. The main artery and vein passing upwards and outwards ran close together, the artery being the more tortuous of the two. These two vessels were very thickly set along a considerable

tract by fine pigment granules which began at about two disc breadths from the disc; they lay to a great extent in front of the vessels, but not so thickly as to quite obscure them; amongst the pigment dots were a few bright highly reflecting ones; excepting that the artery was tortuous the two vessels looked quite healthy. I examined the eye again nearly six years later (Dec. 1885); by the most careful scrutiny I now could find no trace of the pigment,—nothing but a few bright white dots running along the vein; as shown in Fig. 2, the artery was as tortuous as before.

I should add that the pigment dots seen at the first examination were black.

Change in the Colour of Healthy Irides.

Mrs. F. brought me her son (P. 3, p. 145), æt. 14, in 1879, for myopia of about 10 D.

His mother told me, without being asked, that his eyes (irides) had changed colour; they were now of a uniform greenish-grey without spots; she said "they used to be dark brown and are now quite different."

The boy had dark crisp hair and dark skin; his features also were suggestive of a strain of African blood.

Another case is that of a young lady æt. 23 (P. 6, p. 126). The iris of the left eye, after passing through a long attack of chronic irido-cyclitis, was found to be uniformly grey, the other one which had not been diseased being brown, she was quite sure that the two irides had been alike, but for this I had only her statement. In this as in the last case there was some myopia, more in the diseased eye.

ON SYMPATHETIC INFLAMMATION OF THE EYEBALL.

By R. Marcus Gunn, M.A., M.B.,
Assistant Surgeon to the Hospital.

(Continued from p. 102.)

As previously mentioned, I am indebted to Dr. Brailey for the pathological notes on the enucleated eyeballs.

Case XXI.—*Severe Sympathetic Ophthalmitis following the Operation of Iridodesis. Iridectomy and later Cataract Extraction on Sympathising Eye. Result fairly good.*

Alice S., æt. 11. Admitted June 20, 1878.

Was treated here four years ago. The in-patient notes of that date are, " April 24, 1874, lamellar cataract both. Iridodesis in left. Discharged April 29, progressing favourably."

The *left* eye has been inflamed almost ever since this operation. There is now a small cystoid cicatrix near inner corneal margin at the position of the iridodesis. Iris adherent to cornea at periphery. ? Barest perception of light. + T. 1 ? *Right* eye, pupil excluded; anterior chamber very shallow; iris adherent to the cornea at several points near the periphery. Distinguishes hand-reflex in outer part of field. + T. 1 ? Atropine has no effect on either iris. 20. *Right.* Iridectomy upwards. July 1. *Right.* T.n. Counts fingers at 6 inches in outer part of field. Discharged.

Re-admitted November 11, 1878. The right eye has remained quiet. 12. *Right.* Linear corneal incision upwards, and lens extracted; it was porridgy in consistence, and came away piecemeal. A little soft matter left in pupil. December 12. Pupil of good size, but has opaque membrane in it. Discharged.

Examined June 11, 1884. Eyes look quiet, but they are both very tender to the touch, especially the left. *Right.* Pupil slightly drawn upwards, occupied by a little opaque lens substance and membrane. T.n., but full. There is barely any

fundus reflex with ophthalmoscope. With +9 D. V. $= \frac{20}{100}$, and with +13 D. sees letters of Jaeger 12. (She is almost quite illiterate, and was tested with illiterate type.) *Left* eye. + T. 1 ? Counts fingers at 10 inches.

Case XXII.—*Wound in Ciliary Region, followed after some Weeks by Sympathetic Inflammation of a Mild Type. Excision. Result good.*

William E., 34. Admitted Nov. 21, 1878.

His *left* eye was struck by an iron rivet 11 or 12 weeks ago. There has been a wound of cornea and ciliary region down and in, leaving a puckered scar. Pupil fairly active to light, but the iris is lustreless, and evidently slightly inflamed. Counts fingers at 1 foot. *Right* eye. Sympathetic iritis of mild type. Pupil responds fairly to light. There has been a slight effusion of lymph at edge of pupil. V. $= \frac{20}{30}$, and Jaeger 1. The left eye was excised immediately on admission. Ordered atropine drops six times daily to right eye, and to wear a black bandage. Dec. 4. Pupil well dilated. There is a ring of dots of uvea on anterior capsule, where the iris has been slightly adherent. T.n. V. $= \frac{20}{40}$ fairly, with + 50″ sph. $\frac{20}{20}$ partly. Discharged.

Pathological Examination.—Eye of about normal size. T. −1. A. c. shallow; slight haze of cornea near wound, which is at the lower periphery, extending into ciliary region. *On equatorial section* a good deal of syrupy, slightly yellowish fluid escaped. The vitreous is shrunken and detached from its posterior attachments as far as the ciliary body. The fundus is generally of a dull dark purplish colour, with a superficial whitish haze, which is most marked in the neighbourhood of the optic disc, which is a little swollen, and slightly redder than usual; its margins are hazy, especially above and below. The haze extends rather further along the course of the retinal vessels. The y.s. is a small dark point in a hazy whitish-purple area.

In the anterior half of the globe the vitreous remains *in*

situ. On the lowermost part of the ciliary processes is a dense bluish-white partly fibrous layer, which extends into the vitreous as well as on to the adjacent lens margin. Its contraction has drawn up the lower part of the retina away from the choroid into a prominent fold. Elsewhere the ciliary processes appear normal. The lens is somewhat yellowish, but transparent. Near the centre of its posterior surface is a blood stain.

Microscopical Examination.—Sections of the upper ciliary region show the fibres of the ciliary muscle to be normal in size and disposition, and the iris to be a little inflamed, though not thickened. In the lower ciliary region the iris is absent, and its place is occupied by much fibrous tissue, which extends from the edges of the wound into the corresponding part of the anterior chamber and internal surface of the ciliary body. The choroid shows in places well-marked and well-defined clusters of inflammatory cells which occupy its central strata. The optic nerve is healthy, except that an excess of nuclei is seen between its sheaths and around the blood-vessels in the optic papilla. The lamina cribrosa is not pushed back.

Case XXIII.—*One Eye Lost from Injury. Sympathetic Inflammation eleven years later, apparently induced by Superficial Irritation from Foreign Body. Result Unfavourable.*

Edwin J. B., 31. Admitted May 7, 1878.

Left eye injured 15 years ago by a hailstone, and was afterwards "blind." Excised elsewhere four years ago.

Right eye was irritated by a small foreign body four years ago, shortly before the excision of the left, and the redness continued for a long time. The pupil is now excluded and occluded, and the iris bulging forward. — T. 3. Barest perception of light.

It seems probable that the left was excised on account of the symptoms then in the right, and that the redness mentioned was really in association with sympathetic inflammation.

Case XXIV.—*Sympathetic Irritation following a Blow. A Second Injury to Exciting Eye two months later, quickly followed by Sympathetic Inflammation. Excision of Exciting, Recovery of Sympathising Eye.*

John R., 48. Admitted June 5, 1878.

Left eye. Injured last March, by a piece of wood striking it while he was engaged chopping. He had very little pain until three weeks ago, when it was hit by a man's elbow. Since then it has been painful. Has now bare perception of hand-reflex. The *right* eye used to fret and weep when the left was sore. About 16 days ago it began to get dim and itch. *Left.* Excised immediately on admission. 6. *Right.* Pupil sluggish. T.n. Ciliary injection, especially below. Fine posterior synechiæ. V. $= \frac{20}{40}$ fairly, with $-$ 40″ sph. $= \frac{20}{20}$ almost perfectly. Ordered atropine drops frequently, to wear a dark bandage, and to take a mercurial. 22. Has had severe pain on one or two occasions during the night. Pupil has been widely and uniformly dilated for the last week. The gums are slightly touched.

July 5. No injection. A circle of uvea on anterior capsule, showing where the contracted pupil was adherent. V. $= \frac{20}{20}$ barely, with + 60″ sph. Ophthalmoscope shows the disc to be injected with a hazy inner margin. Venous pulse. T.n., but low. Discharged to-day.

He was not again examined, and died a few years later.

Pathological Examination.—The globe appears of normal size and shape. The iris to the naked eye does not appear thickened. The pupil is small, elongated transversely, and displaced outwards. The posterior synechia involves only the pupillary margin below, but in other parts the whole posterior iris surface is adherent. *Equatorial Section:*—The vitreous is clear. The substance of the lens is clear; on its posterior surface near and extending up to its outer margin is a small area, opaque from a deposit of lymph, which extends also on to the adjacent ciliary folds for about one-half of their length. The attenuated apices of these folds are adherent to the lymph on the lens margin, being apparently under some tension. The eye appears normal in other respects.

CASE XXV.—*Incised Wound of Eyeball, followed by Sympathetic Inflammation two months later. Periodic Attacks of Pain and Dimness for many years. Slight Improvement after Excision of the Injured and Iridectomy on the Sympathising Eye.*

Valgerdur J., 20. Admitted Jan. 4, 1878.

Right eye was injured and rendered sightless when she was six years old by her falling upon a knife. It was excised here three years ago. (No notes can be found.) The left eye was first affected about two months after the accident; there was then pain and dimness. She could not see for some time. Ever since then she has had occasional attacks of dimness with pain, less frequently since the removal of the right. She used to have them about twice a year. Shortly after the excision she had an attack, and another 21 months ago. The present attack came next, and began three weeks ago. She has had pain in the eye and vertex, and "neuralgia" in the supra-orbital region, and behind the corresponding ear. The neuralgia has been getting better for the last two days, but the pain in the back of the eye continues. No toothache. In the last year her catamenia have been very irregular, and she has had leucorrhœa. Better again for the last two months.

Left eye. Punctate keratitis. Pupil irregular; small coloboma inwards, result of an iridectomy three weeks after excision. T.n., but full. Counts fingers at 2 feet. Ordered belladonna fomentation, atropine drops, and Heurteloup's leech to temple. 7. More pain in eyeball. Complains that "everything looks red." 21. Has had one or two attacks of pain in eyeball and cheek, generally relieved by Heurteloup. 23. Has rubeola. Transferred to another hospital.

On convalescence she returned to her native island of Iceland. In March, 1884, she writes to friends in London that she has had very bad neuralgia in the left eye all winter, which has left it very weak.

Examined April 7, 1885. Has recently returned to England. While at home since last examination she has had two attacks of ocular inflammation, with an interval of about three years between them. The attack begins with pain in the left side of the face and head, and then the eye becomes affected. She is liable to slight attacks of pain in the head from cold.

There is now a slight greyish nebula of the cornea near its lower margin. The anterior chamber is of good depth, and the iris looks normal in lustre. Anterior ciliary vessels slightly enlarged. Many posterior synechiæ; slight opaque film of organised lymph in centre of pupil, with uvea over part of it. Good artificial coloboma inwards. The periphery of the lens is clear, but centrally there is a slight haze, like that of zonular cataract. (She says, however, that her sight was quite good before the injury; while there is no history of convulsions, and her teeth have sound enamel.) Iris reacts feebly to light. T.n., but rather low. V. $= \frac{8}{200}$; c $-$ 3·75 D. $= \frac{20}{200}$. Reads Jaeger 6 at 6 inches.

Re-admitted to hospital June 13, 1885. The eye became painful a day or two ago. There is very slight general congestion of the globe, with recent keratitis punctata downwards and centrally. T.n. Reads Jaeger 16. Ordered Heurteloup's leech to the temple; atropine drops; warm collyria; arsenic internally. To wear dark glasses.

July 2. No injection now. Cornea clearing. 16. Cornea much clearer. Discharged.

Re-admitted July 30. Recurrence of pain. There is no injection. There is fresh keratitis punctata. T.n. Reads Jaeger 16. Treatment as before. Aug. 29. Discharged.

Examined May 6, 1886. The eye has been quite quiet for the last three months or so; it gradually got stronger after leaving the hospital. Diffuse haze in the lower part of the cornea. No details of the fundus visible on account of the lenticular opacity. T.n. V. c $-$ 2·5 D $= \frac{20}{100}$ partly. Reads words of Jaeger 4 at 4″.

Case XXVI.—*Wound with Prolapse of Iris. Operation performed two months later. Sympathetic Inflammation soon followed this Operation. Excision of Injured Eye. Useful Vision retained in the Sympathising Eye.*

Ann A., 18. Admitted Dec. 31, 1877.

Left eye. Wounded 11 months ago by the latch of a door. Two months later she says an operation was done on this eye (under anæsthetic), but its nature cannot be determined, as no

notes can be found; it probably consisted in cutting off a prolapse of iris. The *right* eye began to be dim-sighted nine days after this operation, with lacrymation and photophobia. There never has been pain in it.

Left. Cicatrix at lower outer margin of cornea with pupil drawn down to it. Iris lustreless and woolly; marked ciliary injection. —T. 1. Entropion of lower lid, apparently the result of the photophobia.

Right. Iris lustreless. Pupil small and inactive, with numerous adhesions to lens capsule. —T. 1 ? V. = fingers at 5 feet or more. Intense photophobia. *Left.* Excised. Ordered atropine drops frequently to right. Dark bandage.

Jan. 3, 1878. The pupil has not yet dilated at all. Thin layer of lymph over pupillary area. Fundus fairly well illuminated, but the eye is too irritable to bear prolonged examination. Counts fingers at 14 feet. 7. Discharged.

No further notes could be obtained.

Pathological Examination.—Globe somewhat shrunken, and rather squared. Antero-posterior measurement, 21 mm.; lat., 23 mm.; vert., 21·5 mm. —T. $1\frac{1}{2}$; marked ciliary injection. Cornea clear. Anterior chamber extremely shallow. Pupil displaced to extreme lower and outer side, and blocked by whitish-grey opaque lymph. The iris appears woolly, and coarsely striated radially. *Equatorial Section:*—The sclerotic measures in thickness at its upper equator 0·7 mm.; at outer, 0·5; inner, 0·6; lower, 0·8 mm. The vitreous appears to be replaced entirely by a thin, slightly yellowish fluid. The optic disc is rather swollen at its edges, from which a slight greyish-white radiating opacity gradually shades off into the surrounding retina. It shows a small central depression, with overhanging margin. A small fold of retinal detachment extends from the upper part of the disc to the yellow spot. The lens is *in situ*, and clear, except that on its posterior capsule, all but its central part, is a bluish-white opaque layer, which extends on to the adjacent anterior half of the ciliary zone. This layer extends furthest and is thickest below and outwards, corresponding to the position of the displaced pupil. The central ciliary zone is generally deficient in pigment. The zone just behind the ora serrata is of a brownish-grey colour, being very finely speckled, with minute greyish atrophic dots. The posterior part of the fundus is of a more brown-red than normal.

CASE XXVII.—*Cataract Extraction, followed by Inflammation and Ultimate Shrinking. Sympathetic Ophthalmitis three months after the Operation. Excision of Lost Eye. Iridectomy, and subsequently Extraction and Iridotomy in Sympathising Eye with Good Result.*

George S., 62. Admitted Nov. 27, 1876.

Left eye. An immature cataract was removed elsewhere on Feb. 23 last. Inflammation followed. On June 1 he was admitted into Moorfields. The left eye was then atrophied and sightless, and the *right* eye had been inflamed for nine days with pain, ciliary injection, and sluggish pupil. The left was at that time excised, and an iridectomy upwards done in the right, leaving a good coloboma. This eye became stronger for a few days after the iridectomy, and he soon left the hospital. About a week after returning home, he was seized with severe pain in the right eye and temple. On Sept. 7 he was again admitted into this hospital. The notes then are, "*Right*, sympathetic iritis. + T. 1. Cataract. V. = hand-reflex. Curette extraction, and a little of the capsule removed by forceps. Sept. 29. Counts fingers at 4 inches. — T. 1. Discharged."

The coloboma is now filled with lymph. V. = bare perception of shadows. — T. 1 ? 28. Incision made from outer side with Taylor's knife, and the lymph cut through with it. Weiss's scissors then used to enlarge the opening. Dec. 8. Doing well. Counts fingers at about 2 feet. Dec. 23. With + $3\frac{1}{2}''$ sph. V. = $\frac{10}{200}$; with + 2″ reads Jaeger 16. Discharged.

April 17, 1877. With + 8″ cyl. axis 30° down and out from vertical and + 4″ sph. V. = $\frac{20}{200}$; with same cylinder and + 2″ sph. reads Jaeger 6 slowly.

On May 28, 1884. He was able to do his farm work, go to market, &c.

Pathological Examination.—The eye is shrunken. The cornea is thicker than usual, and especially above in the neighbourhood of the scar of the cataract extraction. The sclerotic just behind the scar is drawn in very markedly, so as to make a rather deep groove, which is most conspicuous at the upper and inner part. The iris is also clearly adherent to the scar. On antero-

posterior vertical section a yellowish turbid fluid escaped. The retina is detached except from the optic disc and its ciliary attachments, though it is not much contracted. The sclerotic is very thick behind, and also rather thicker than normal throughout the greater part of the rest of its extent. The anterior chamber is reduced to a mere chink. A whitish-grey layer of lymph is seen on the anterior surface of the iris. The pupil is occluded. The ciliary processes are stretched away from the sclerotic *below*, towards the axis of the eye, but the external layer of the ciliary body still retains its normal position in relation to the sclerotic. The consequence is that the lower part of the ciliary body, as seen in meridional section, is extended so as to occupy several times its normal thickness. The sclerotic on this side suddenly becomes extremely thin at the insertion of the inferior rectus, and the thinning extends forwards as far as the corneal margin. In the upper ciliary region there is a similar traction of the ciliary processes towards the axis of the globe, so that here the ciliary body is also extended in an exactly similar manner, though by no means to so great an extent. This stretching of the ciliary body seems as if it had been produced by the contraction of the retina drawing on its anterior attachment. The most anterior part of the operation wound seems a little in front of the line of the sclero-corneal junction.

Case XXVIII.—*Cataract Extraction followed by late Panophthalmitis. Severe Sympathetic Inflammation, but Date of Onset Unknown.*

Henry C., 79. Admitted Dec. 23, 1877.

Left. Panophthalmitis with gaping wound below, through which the iris is protruding. Had cataract extraction performed elsewhere, about a year ago. The result was bad at the time. There has been slight pain ever since.

Right. His sight began gradually to fail six years ago, doubtless from cataract. Has had no pain, and it is impossible to say when inflammation commenced. He was examined here before the removal of the left cataract, and there was then no note of iritis, but only of cataract in both. The cornea is now steamy. + T. 2. Pupil excluded. Bare perception of light.

Jan. 1, 1878. Left excised. Discharged Jan. 5.

No further information could be obtained.

Pathological Examination.—The globe is collapsed. It was opened at the optic nerve entrance during the excision. Just inside the lower corneal margin the incision of the cataract extraction is visible. *Equatorial Section :*—The sclerotic appears to be of greatly increased rigidity. Its apparent thickness is greatly added to by a tough closely adherent rather gelatinous-looking layer. This appearance is due to an infiltration of albuminous substance into the thin connective tissue layer, which normally clothes its external surface. A cavity the size of a pea, with thick walls, is visible at the lower and inner part of the section. In this is contained a pale reddish-brown fluid, intermixed with some soft shreds of a purulent appearance. This cavity is apparently that of the detached retina. The space between this layer and the sclerotic is entirely filled up as to its peripheral half by a greyish translucent tough substance, apparently the vastly thickened choroid, and, internally to this, by a reddish semi-solid substance, probably the remains of blood, exuded between choroid and retina. Scarcely any remains of a pigment layer can be traced in the position of the retinal pigment epithelium. A vertical antero-posterior section of the anterior half of the globe shows the iris much thickened. In front it is in contact with the cornea. A pinkish-red layer is seen on and closely adherent to its posterior surface, the two being separated by a slightly irregular black pigment line. Further back again, is a whitish-yellow purulent mass, evidently the remains of the shrunken and suppurated vitreous.

Case XXIX.—*Severe Sympathetic Inflammation about four years after an Injury of the other Eye. Excision of the Exciting Eye. Result Unfavourable.*

Wm. S., æt. 61. Admitted Jan. 17, 1879.

Right eye. Injured by a blow with a candlestick four or five years ago. It has been blind ever since. About four months ago this eye was struck with a piece of coal. The centre of the cornea has since given way from ulceration; the lens was found lying partly out of the aperture some days ago, and removed. *Left* eye. The sight began to fail about six months ago; it was then inflamed and painful. *Right.* Globe somewhat shrunken.

There is a round hole in centre of cornea, as if a piece had been punched out. Purolymph at bottom of a. c. No perception of light. — T.n? *Left.* Much conjunctival and ciliary injection. Central circumscribed haze of cornea. Pupil excluded and occluded by dense layer of lymph. V. = bare perception of hand-reflex. + T. 1. 18. *Right.* Excised. 22. *Left.* Pain very slight. Gutt. Atrop. ordered. 24. Small dark coagulated ecchymosis from small superficial vessels on upper corneal periphery.

Feb. 1. Much pain. Heurteloup. 13. The eye is getting steadily worse. There is a yellowish-grey deposit of purolymph at the lower outer part of the a. c. (He sleeps on his left side.) Still considerable pain. V. = hand-reflex barely. Is having mercurials now.

March 31. The eye has been very painful yesterday and to-day. The purolymph has gradually contracted from the rest of the chamber into the pupil, where there is a large dense lump. There are still small flocculi of deposit on the posterior surface of the cornea down and out and below.

April 14. Much pain again for the last two days; almost sleepless. There is more purolymph in upper part of a. c. Much lacrimation.

May 10. Globe very tender. Much injection. Much pus in a. c. and cornea. Barest perception of light. Discharged.

Pathological Examination.—The globe is rather soft. — T. 1. Its measurements are:—Antero-posterior, 22·5 mm.; lateral, 24 mm.; vertical, 25 mm. The cornea is quite flat, except at its centre, where there is an aperture forming a pit, the depth of which is apparently much greater than the corneal thickness, and through which a smallish flattened globular body, apparently the lens nucleus, escaped some days ago. The cornea bordering on this hole is whitish, semi-opaque, and vascular, but its more peripheral part is clearer. *Equatorial Section:*— The sclerotic is seen to be less rigid than usual, and of normal thickness. The retina, soft and detached from its posterior connections, lies on and defines posteriorly a translucent mass, which clothes the posterior lens capsule and the ciliary processes. In the centre of the anterior part of this mass is a white cheesy substance, containing some particles which are hard and apparently calcareous, the whole being apparently the remains

of an abscess in the vitreous. This extends right up to the depression in the corneal centre. The margins of this depression are much pulled in, as if under considerable traction from within. The rest of the cornea has the iris closely in relation with its posterior surface as far as the perforation, where the iris comes into relation also with the cheesy mass. Between the choroid and retina is a thin yellowish-brown fluid. The ciliary body is tough and much thickened, as if by infiltration with some semi-translucent substance. The same change affects the anterior part of the choroid, whereas further back this tunic is normal.

Microscopically the changes in iris, ciliary body, and choroid consist in infiltration of their tissue with inflammatory cells collected in groups. Similar cells are exuded on their internal surfaces. These cells are partially organised into tough connective tissue.

Case XXX.—*Severe Sympathetic Ophthalmitis several months after Cataract Extraction in other Eye. Loss and Excision of Sympathising Eye, Exciting Eye remaining Quiet, with Good Vision.*

James W., æt. 77. Admitted July 23, 1879.

Right eye. Modified Graefe cataract extraction here in July, 1878. The lens was hard and large, but came away well. Slight bleeding into a. c. Severe iritis followed, with recurrence of bleeding into a. c., and ultimately hypopyon. *Left* eye has been inflamed and painful for last two months; worse during last three weeks. *Right.* Conjunctiva clear and uninjected, and eye perfectly quiet. Good pupil. T.n. V. is good; with correction $= \frac{20}{30}$ fairly, and J. 1 fluently. *Left.* Conjunctival and ciliary injection. Superficial haze of cornea; loss of epithelium over lower half. Pupil quite excluded and occluded. Iris slightly bulging. No perception of light. + T. 2. *Left* excised.

Discharged July 29.

Pathological Examination.—There is a conjunctival and ciliary injection, with superficial haze over the lower half of the cornea. The pupil is excluded and occluded. The tension is increased (T. + 2). *Equatorial Section:*—The sclerotic is of

normal thickness. The vitreous forms a slightly tough transparent mass, adherent to the posterior surface of the ciliary processes and lens. The retina is *in situ*, though it is apparently not at all adherent to the choroid. The optic disc is slightly depressed, and is surrounded with an area of retinal haze. The lens is *in situ* and opaque. The iris is adherent to its anterior capsule, except near its periphery, where it is bulged forwards, as if by a pressure of fluid from behind. The iris tissue is inflamed, but not materially thickened. It contains in its interior no marked groups of inflammatory cells, as is usually the case in eyes that have *excited* sympathetic disease. Nor is there any exudation behind its uveal pigment layer, or on the internal surface of the ciliary body.

Case XXXI.—*Corneal Ulceration leading to Perforation and Anterior Synechia. Recurrent Attacks of Pain. Sympathetic Inflammation some months later. Improvement after Excision of Exciting Eye.*

John A., 52. Admitted Jan. 4, 1879.

A tall thin man, with brown hair and bluish-grey irides. No personal history of syphilis, rheumatism, or gout. He served in the army in India from 1862 till 1873. Health has been bad. In July last the left eye was inflamed and painful, seemingly a corneal abscess. This continued for three or four weeks, and since then he has had pain on and off. About the end of November the right eye became red and painful; there was lacrymation and photophobia. The sight has been getting gradually worse ever since.

Left eye. Globe somewhat shrunken and injected. Large vascular leucoma, with extensive anterior synechia; anterior chamber shallow. V. = barest perception of light. — T. l. *Right* eye. Injection of conjunctiva and of ciliary region. Keratitis punctata. The pupil dilates fairly well under atropine; one posterior synechia up and in, and much uvea in small dots on anterior lens capsule. Fundus seems normal. V. = Jaeger 19 with difficulty, and counts fingers at about 3 feet. T.n. He complains of much pain in right temple. Ordered atropine drops, iodide of potassium mixture, and blister behind right ear. To wear dark bandage. 8. Improved. *Right.*

Pupil dilating well and less injection. 15. *Right.* V. is worse. The keratitis punctata has increased. *Left.* Excised. 23. *Right.* V. improved, now $= \frac{20}{200}$; counts fingers at 12 feet. Discharged.

No further notes could be obtained.

Pathological Examination.—The eye is soft (T. — 1), and slightly shrunken, its measurements being—Antero-posterior diameter, 22·5 mm.; lateral, 24·5 mm.; vertical, 23 mm. The cornea is rather small. It is occupied by large, white, not very dense leucoma, except *below and internally* where there is a clear patch with visible iris, and *above and outwards* where is a similar though smaller and less clear area. *Equatorial Section:* —The sclerotic seems about normal. The vitreous is shrunken to a small, yellowish, translucent globe on the ciliary processes and lens area, and from it to the optic disc there extends a narrow peduncular portion. Between these vitreous remains and the choroid is a thin, yellowish, clear fluid. The lens is *in situ.* It has a hard nucleus and much peripheral soft matter. The iris is universally adherent to the cornea. There is an exudation of lymph behind it and on the anterior portion of the ciliary circle, especially below where it extends, gradually thinning in its course, backwards to the ora serrata. This lymph is of a dirty white colour with a slight greenish tinge. It is dense and, apparently, not purulent in character. The optic disc is hazy and similar haze is seen at the yellow spot. Its blood-vessels are small.

Microscopically the iris is much thickened, adherent to the cornea at its centre but free at its periphery. Characteristic groups of inflammatory cells are seen in it, the ciliary body and the choroid. Inflammatory exudation, partly organised into tough connective tissue, clothes the posterior iris surface and the internal aspect of the ciliary body.

Case XXXII.—*Severe Sympathetic Inflammation occurring three weeks after an injury to the other Eye. Excision of the Exciting Eye. Result Unfavourable.*

Elizabeth D., 35, admitted March 10, 1879.

A dark-haired Irishwoman of nervous temperament. General history unimportant.

Right eye lost from a blow (fist or boot) about five years ago. For three weeks the sight of the left remained quite good, but then it was seized with severe pain accompanied by dimness of sight and coruscations. About five weeks later the right was excised. She has occasionally had severe pain across the forehead and in the left temple: it never lasts long. *Left.* Ciliary atrophy with marked engorgement of the ciliary vessels. There is a small ciliary staphyloma down and in. Cornea slightly nebulous. Anterior chamber shallow; peripheral adhesion of iris to cornea up and out. Pupil excluded and occluded. V. = bare perception of light. She has occasional flashes of light, "scarlet and blue and all colours." + T. 2. 11. Incision upwards: a small piece of iris removed piecemeal. 12. Atropine drops. 15. About one-sixth blood in anterior chamber. Ordered hot belladonna fomentation. 20. Blood almost gone. V = bare perception of light. Small coloboma above. T.n. Discharged.

Case XXXIII.—*Shrunken Globe from old injury excised for Sympathetic Irritation. Iritis followed some time afterwards, probably sympathetic in nature. Iridectomy several years later with extraction of Cataractous Lens. Result fairly good.*

George B., æt. 58, admitted May 6, 1878.

The *left* eye was excised here about 13 years ago. Notes as follows: "Sept. 15, 1864. *Left* shrunken bulb after injury with stick 30 years ago. For last 18 months it has been painful on and off. *Right* feels very weak, but there is not the slightest redness. *Left* excised. Globe contained bone with pus on surface (?). 19. Discharged." He says the left was cut by a piece of broken stick. He saw for a week or two, but then the sight went away from this eye entirely. After the excision of the left he could see to do his work (as tailor) for some months, and he even did a little for some years, "but not like what I used to do." He had to take frequent rests. There is now a small nebula near the inner periphery of the cornea. No history of ulceration. The pupil is small, irregular, and acts imperfectly to light. Iris atrophic. T.n. V. = $\frac{3}{200}$, not improved by

spherical glasses: spells words of Jäeger 19 at 4 inches. His sight varies from time to time he says, occasionally becoming very dim. Ordered atropine drops once daily. 8. No effect from atropine. Discharged May 14.

Re-admitted in April, 1884, when iridectomy was done as a preliminary to extraction of the then cataractous lens.

Examined May 24. Eye quiet. Good coloboma upwards. Lens cataractous. T.n. V. = hand-reflex barely.

Re-admitted June 20, 1884. Conjunctiva slightly injected; anterior chamber rather shallow. Pupil small, updrawn; coloboma upwards. Lens fully opaque; iris is rather bulged by lens, and is cribriform at lower part. T.n. V. = shadows. Projection good. 23. Extraction upwards through coloboma. Lens came away with difficulty and much soft matter was left behind. July 1. Pupil updrawn but clear. 11. V. $\bar{c}$ +18 D. cannot decipher Jaeger 20.

Re-admitted Oct. 8. Cornea slightly hazy at lower part. Pupil drawn up. T.n. V. $\bar{c}$ +18 D. = Jaeger 16. 10. Incision down and in with bent broad needle. Unsuccessful attempt to withdraw iris with forceps. Tyrrell's hook then introduced, and iridectomy down and in effected. Slight bleeding into anterior chamber. 13. Slight general injection. Good artificial pupil, but covered by thick membrane. V. $\bar{c}$ +18 D. = Jaeger 16. Discharged.

Examined April 21, 1886. Eye looks quiet and never troubles him now. T.n. Pupil large, overspread by membrane except below: through this gap the disc can be seen dimly and looks normal. No change seen in fundus. There are numerous opaque lines in the anterior part of the vitreous below the membrane. V. $\bar{c}$ +18 D. = Jaeger 16.

Examined Dec. 29, 1886. No family history of rheumatism. He never suffered from joint-pains previously to the sympathetic inflammation, but during the past year has had "rheumatic" pains in his feet and legs. His eye is *in statu quo*.

It is probable that a more thorough examination would have detected some evidence of sympathetic inflammation before the excision of the exciting eye.

Case XXXIV.—*Prolapse of Iris following Corneal Section for Abscess. Sympathetic Irritation about six weeks later, and Exciting Eye then Excised. Iritis first observed in Sympathising Eye four weeks after the Excision. Inflammation very severe, with great pain. Sclerotomy done for relief of Secondary Glaucoma. Ultimate Loss of Globe.*

Edward R., æt. 51. Admitted August 5, 1879.

About two months ago the left eye became inflamed and painful. No history of injury. He was in hospital last winter with rheumatic fever. His general health is rather feeble: has had loss of voice for many years.

Left. Large onyx down and out. *Right.* V. $\frac{20}{20}$. No Hm.

Left. Corneal section through onyx. Ordered hot fomentations and eserine drops. 10. *Left.* No a. c. Pain at times. 27. *Left.* Large prolapse of iris down and out. T.n. Considerable injection: no pain. V. = bare perception of light. Discharged.

Re-admitted September 25, 1879. For the last eight or nine days the right eye has been watery and dim-sighted; occasional aching pain in left.

Present condition. Right eye, photophobia, lacrymation, considerable injection. Cornea clear; good anterior chamber. Pupil rather widely dilated and sluggish (? partially under atropine). V. = $\frac{20}{20}$. No Hm. T.n. *Left* eye. Much injection. Large prolapse of iris at old wound, rest of cornea slightly hazy. V. = Hand-reflex. — T. 26. *Left* excised. 27. *Right* pupil active. Complains of gumming of eyelids. To use astringent lotion. Oct. 2. Pupil active but oscillatory. Ciliary injection. Sight dim. Ordered atropine drops. 8. T. + ? 24. Much pain all last night. Iritis. Nov. 11. Posterior synechiæ forming (the atropine drops discontinued lately by surgeon's desire). Severe headache and morning sickness, with vomiting before breakfast. Nov. 21. Occasional attacks of severe pain, and morning sickness. Much conjunctival injection and gumming of eyelids. Dec. 16. For the last six weeks he has suffered much from severe headaches, chiefly in the right forehead, only relieved by subcutaneous injection of morphia.

23. Blisters and leeching have been tried without relief. Still much lacrymation and conjunctival injection. T. + ? Posterior synechiæ. V. = fingers at 9″. Jan. 9, 1880. V. = fingers at 2 feet. 17 + T. 1? Has been feeling easier lately. Feb. 6. Has had no pain for five weeks; considerable bulging of iris; + T. 16. Severe pain in temple. Redness and bulging of iris increasing. + T. 1. March 4. Eye injected but not painful. + T. 1. Pupil semi-dilated. Complete exclusion of pupil with bulging of whole iris; anterior chamber deep in centre. V. = letters of Jaeger 20. 5. Sclerotomy upwards, but not far backwards. Slight bleeding into anterior chamber. 6. Iris flatter. T.n. Eye feels more comfortable. 15. T. + ? 18. Eye quiet. T. + ? Good anterior chamber with a little blood in it. Iris fairly flat, slight bulging to inner side. Counts fingers slowly at 5″.

Discharged.

Examined April 7, 1886. The globe is now much shrunken and squared and has long been absolutely sightless.

Pathological Examination.—Globe normal in size and shape. The cornea exhibits near its lower and outer margin a brownish slightly prominent area corresponding to an interior synechia, as if the cornea had been necrosed and the exposed iris covered with but a very thin layer of organised and translucent lymph. Elsewhere the cornea is transparent, though it looks thin and somewhat irregular, with the iris apparently in contact with it throughout. *On equatorial section* the vitreous is clear and rather less consistent than usual. It separates *en masse*, though not very readily, from its posterior attachments to the optic disc and retina. The optic disc is somewhat indistinct at its margins; its blood-vessels are rather reduced in size, there is a hazy area between it and the *y. s.* which is indicated as a small brown spot. The lens is *in situ*; it is clear except an opaque area due to a thin layer of exudation on its anterior surface. The ciliary processes are not far from normal. Their apices are markedly grey. An irregular greyish band marks the posterior ciliary border. The intermediate part is brown (not black) and is slightly mottled with lighter brown dots and streaks. A vertical section of the anterior half of the globe shows the lens to be adherent to the iris and this to the cornea.

Microscopical Examination.—Meridional sections through the

inner ciliary region show the muscular fibres to be well developed. There is no enlargement of the larger arterial circle. The iris is much thickened by inflammatory cells which lie in its substance as well as behind and among the pigment of its scattered and atrophied uveal layer. Few blood-vessels are visible in the iris, but most of these have their endothelium considerably proliferated. The choroid shows numerous inflammatory cells disposed in groups which occupy its central strata, its blood-vessels are either distended by blood corpuscles or their lumen is partially or entirely blocked by a proliferation of the cells of the endothelium: their walls are thin. The O. D. is swollen. There is a slight increase of the nuclei around the blood-vessels at its centre. There may be slight inflammation of the optic nerve trunk.

CASE XXXV.—*Excision of Globe ten weeks after Perforating Wound. Subsequent severe Sympathetic Inflammation.*

Thomas M., æt. 9. Admitted Aug. 11, 1879.

Left eye injured in Nov., 1875, by falling on a piece of broken glass. The eyeball was removed elsewhere ten weeks later. The *right* was not affected before excision, but shortly afterwards this eye became inflamed.

The *right* eye has been painful since getting a blow upon it a day or two ago. Ciliary injection. Transverse opaque film across cornea, calcareous. Pupil excluded and occluded by dense layer of lymph. Sees hand-reflex. T.n. To have Gutt. Atrop. 18. Eye quiet now. Discharged.

This patient could not be traced again.

CASE XXXVI.—*Perforating Injury of Globe followed by severe Iritis. Excision eight weeks later. Sympathetic Inflammation, probably mild at date of Excision, but becoming severe three months later. Iridectomy. Result unfavourable.*

John H., 65, admitted May 22, 1879.

Right eye injured about eight weeks ago by the recoil of a branch of a thorn bush. The *left* has felt dim occasionally for some days with the appearance of a black speck moving before it. No pain nor photophobia. *Right.* Conjunctival and ciliary injection. Pupil excluded and occluded. +T. 1 or more.

No perception of light. *Left.* Ciliary injection. Pupil small, rather sluggish. Slight haze of middle of lens anteriorly, (?) lymph on capsule. 22. *Right* excised. 26. *Left.* V. $= \frac{20}{50}$ barely; not improved by sphericals. 30. V. $= \frac{20}{40}$. Discharged.

Re-admitted Aug. 28, 1879. He does not consider that the left eye was really affected while in hospital last, but a few days ago he "caught cold" in it. He had swelling of the glands in the left side of the neck, followed by pain in the eye and dimness of sight. He saw bright flashes of light, coloured blue and red. There is now keratitis punctata. +T. 2. Counts figures at 12 inches. Ordered atropine, grey powder, and iodide of potassium. Sept. 4. Iridectomy upwards. 5. T. still full. No pain. 12. T.n. Posterior synechiæ. Opacities in lens. Reads Jaeger 16, and not improved by a glass. 25. Considerable injection, chiefly ciliary. Oct. 2. Sight more dull this morning. +T. 1. Ordered eserine. 23. Sight improving. +T. 1 (?). Lens conjunctival redness. Reads small words of Jaeger 19. Discharged Oct. 23.

Re-admitted March 1, 1880. He has had a good deal of pain in left eye since discharge. Considerable injection, especially ciliary. Bulging of old iridectomy wound. +T. 1 or more. Has barely perception of light. Ordered belladonna fomentation. April 5. Eye much quieter. T.n. Cornea flattened. Shallow anterior chamber. Coloboma of former iridectomy filled with lymph. Cicatrix flatter, and iris more clearly visible. Discharged.

Examined May 4, 1886. Soon after leaving the hospital in 1880 the eye became inflamed and sight gradually left it. It is now shrunken and absolutely blind.

Pathological Examination.—The globe is of normal size. Its measurements are—antero-posterior, 25 mm.; lateral, 24 mm.; vertical, 24·5 mm. The iris is dull and slate-coloured. It is close to the cornea, and apparently thickened at its lower and outer part, but elsewhere the anterior chamber exists. The pupil is extremely small and occluded. *Equatorial Section.*—The sclerotic is of about normal thickness. The vitreous is turbid with greyish films and more dense flocculent

opacities. It is shrunken towards the ciliary body and posterior lens capsule, and separated by thin fluid from the retina behind. The optic disc is much swollen and opaque, the opacities extending into the surrounding retina. The blood-vessels from it are very small. The lens is *in situ* and opaque.

Case XXXVII.—*One Eye lost from Inflammation following Gun-shot Injury. Sympathetic Inflammation of severe type setting in twenty years later, leading to great Impairment of Vision.*

Edwin S., 45, admitted Sept. 9, 1879.

The *right* eye was injured by a gun-shot wound more than 20 years ago. The eye was inflamed and very painful for about six weeks afterwards, and at the end of this time the sight of it was quite gone. The eyeball is now shrunken, but not painful. Eighteen months ago the *left* eye began to be troubled with muscæ, but there was no pain or redness until six months ago. Since this latter date his vision has become very bad. Cornea clear; anterior chamber of good depth; pupil occluded by layer of organised lymph; iris seems everywhere glued down completely to lens-capsule, and large vessels visible upon it, particularly above. T. slightly diminished. V. $= \frac{20}{0}$; reads Jaeger 19 partly, $\bar{c}$ +20″ lens Jaeger 16. The right eye was excised on admission, and atropine drops ordered to the left. Sept. 18. The pupil has dilated very slightly. V. $= \frac{20}{100}$ and Jaeger 16. Ordered dark glasses. Discharged.

No further notes could be obtained.

Case XXXVIII.—*Penetrating Wound of Eyeball followed by severe Sympathetic Inflammation six years later. Excision of Exciting Eye. Result unfavourable.*

Louisa C., 23, admitted Sept. 21, 1879.

Left eye injured by a perforating wound with the steel rib of an umbrella eight years ago. The *right* eye was first inflamed about two years ago. She has had several attacks since then, the last being about nine months ago. During the attack the sight is dim, and everything "dances before the eye;" occasionally there is severe headache in the vertex. *Left.* Conjunc-

tival injection. Cornea clear. —T. 2. Bad perception of light. *Right.* Small dense leucoma in cornea outwards. Numerous posterior synechiæ. T.n. Reads Jaeger 12 at 5 inches. 29. *Left* excised. Oct. 1. Reads letters of Jaeger 6 at 3 inches. Occlusion and exclusion of pupil. Anterior chamber shallow. —T (?). Fundus reflex only. No superficial redness or pain. Discharged.

Examined Jan. 26, 1880. Vision same as on discharge.

Examined May 17, 1884. Since leaving the hospital she has had occasional pain and burning sensation in the eye. Four or five weeks ago a hæmorrhage occurred into the eye, and there are still remains of the blood-clot in the anterior chamber. Pupil excluded. Lens cataractous. —T. 1. V. = bare hand-reflex.

Pathological Examination.—The eye is soft (T. —2), though but little below the normal size, since all diameters = about 23·5 mm. The iris is dull and mottled irregularly with greyish-brown, this being due to an inflammatory change. The pupil is occluded with irregular margin. The anterior chamber exists. *Equatorial section* shows the retina *in situ* and the vitreous separated from it at the posterior pole by a little thin fluid, but otherwise clear and pretty normal. The optic disc is swollen, the choroid is mottled with darker red-brown and grey areas which are apparently due to choroiditis. The lens is *in situ.* It is semi-opaque, and of a yellowish-white colour.

Case XXXIX.—*Lost Globe from Purulent Ophthalmia, and subsequent Injury by Blow. Severe Sympathetic Inflammation some months after the Injury. Excision of Exciting Eye. Result unfavourable.*

Thomas C., æt. 11. Admitted January 27, 1879.

Right eye lost from "purulent ophthalmia" some years ago. Six months ago it was injured by his running against a playmate.

Left eye. For the last fortnight this eye has been affected. It then became red; has ached occasionally, and has had lacrymation and photophobia.

Right. Globe injected. The cornea is shrunken, with superficial leucoma and vascularity. No perception of light.

Left. Ciliary injection; pupil fairly well dilated under atropine. The iris seems to be on two different levels, the periphery being very near the cornea, while the central part is deep, and bound down to a large extent to the lens capsule. Small spots of uvea left on anterior capsule where adhesions have given way. T.n. No details of fundus visible. V. = counting fingers at 2 feet.

Right excised. Atropine and black bandage to left.

Feb. 10. Ordered mercurial inunction. 12. V. = hand-reflex only. Less ciliary injection. March 13. Counts fingers at 8 inches. April 20. Much *in statu quo*. Counts fingers at 14 inches. May 2. Pupil excluded and occluded. Iris vascular. A. c. shallow. —T. 1. Counts fingers at 20 inches. Discharged.

This patient could not be traced again, so that his subsequent history is unknown.

Pathological Examination.—Measurements of globe are: antero-posterior, 23·5 mm.; lateral, 23·5 mm.; vertical, 22·5 mm. Its tension is normal. The cornea is very small, and moderately densely leucomatous all over. It is rather flattened, and presents numerous superficial blood-vessels. On *equatorial section* a thin yellow fluid escapes. The retina is soft, and detached from the choroid into an umbrella shape. Its cavity, small but not tightly contracted, contains the scanty rather tough remains of the vitreous. The choroid is pale brownish-yellow in colour. The yellow spot is in the centre of a darker area. The choroid at the periphery is also rather darker, and is studded with small fine white, or nearly colourless dot-like deposits (apparently colloid nodules in an early stage). The iris is thick and closely adherent to the cornea, except just at a small central area. Its pigment layer is irregularly thickened. The connective tissue layer which lines the ciliary muscle internally is also inflamed and thickened, but the muscular fibres themselves are pretty healthy.

Case XL.—*Repeated Needle Operations for Opaque Membrane after Cataract Extraction. Sympathetic Ophthalmitis about six months after the last needling. Iridectomy, and subsequently Excision of Sympathising Eye. Retention of excellent Vision by Exciting Eye.*

Ann H., æt. 54. Admitted March 20, 1879.

Left eye. Cataract extraction here last August by Mr. Streatfeild's method. The tension of both had previously been noted as rather full, and the operation had to be postponed for a day or two on account of spontaneous conjunctival ecchymosis. The lens came away well, and the eye remained quiet. In November there was opaque membrane in the pupil, which was needled on the 4th. That night there was pain. On the 9th the outer half of the pupil was still covered, and needling was done again. On the 13th there was slight injection and a little tenderness to touch; pupil still partially covered, Jan. 29, 1879. *Left* eye. Opaque membrane in pupil. *Right* eye. Cataract immature, V. $= \frac{4}{200}$. Peculiar glistening appearance of eyeball, but it does not water much. Slight ciliary injection. 30. *Left.* Needled (1 needle). Ordered ice and atropine. Feb. 3. *Left.* Much injected. Slight pain. + T. 1? Empl. Lyttæ. on left mastoid. 5. Eye stronger; complains of muscæ. 21. *Left* too weak still for testing. *Right* stronger than before. Discharged. *Present condition: Left* eye looks quiet. No injection remarked. *Right* eye. Conjunctiva injected and slightly œdematous. Keratitis punctata. Numerous dots all over posterior surface of lower half of cornea. Anterior chamber deep. + T. 1. V. much worse than when last tested. Ordered atropine drops and black bandage. 31. *Right* eye. Last evening she had heavy pain above outer part of this eyeball, relieved by a gush of tears. Still much ciliary injection. + T. 2. April 3. Severe throbbing pain for last two days or so in both temples, generally alternating. This pain makes her feel sick. R. E. + T. 2; L. E. + T. 1. 6. R. E. + T. 2. Vision slightly improved. L. E. T.n. Feels stronger. 14. R. E. + T. 1? Cornea brighter, and eye generally quieter. Discharged April 14.

Re-admitted April 24, 1879. *Left* eye quiet. Pupil slightly

drawn up. Adhesion of iris to scar. *Right.* Conjunctiva slightly chemosed. Cornea hazy. Posterior synechiæ. V. = hand-reflex. + T. 2. Iridectomy upwards to-day. 26. Blood in a. c. since operation; a. c. reformed, but very shallow. 30. Pain varies from day to day; less injection. May 2. Occasional throbbing in outer part of eyeball; much lacrymation. T.n. Capsule of lens covered by lymph. 12. Glands of right side of face and neck swollen. Much pain in this cheek. Less lacrymation. 17. Yellow purolymph in pupil for last few days. Still much photophobia. 26. Small irregular opacity at posterior part of cornea near centre. June 11. *Right* eye quieter. Discharged. Re-admitted July 10, 1879. About a week ago the right eye became inflamed and very painful. There is now much swelling of lids and œdema of conjunctiva. Bulging of ciliary region above. Central onyx of cornea. + T. 1. V. = hand-reflex. Corneal section made through onyx. Ordered poppy-fomentation. 13. Cornea clearing. 24. She has had several severe attacks of pain lately, and wishes to have the right eye removed. R.E. excised. 31. L. c + 3″. V. = $\frac{20}{40}$, partly, c + 2″, reads Jaeger 1 at 6″. Eye still weak. Discharged. August, 1886. She writes to say that the eye continued well until last November, when it became red. This redness continued more or less till March (1886), when pain and dimness came on, and she then attended Moorfields as an out-patient once. With rest and treatment the attack soon passed off, but the sight is not quite so good as before. Dec., 1886. Writes that she believes her sight is not worse than it was in August.

Pathological Examination.—The globe is hard (T. + 1), and not much below the normal size, all diameters measuring about 24 mm. The cornea is opaque: a transverse scar (about half its breadth) extends across its centre; just above its upper margin the ciliary region is pale and slightly prominent as if from some degree of staphylomatous bulging. An *equatorial section* shows the vitreous to be clear, but rather firm, and apparently rather more stringy in its texture than usual. The retina and choroid are *in situ.* The optic disc is rather swollen; its blood-vessels are small and appear streaked with white along their sides. The yellow spot is a dark point surrounded by a rather less dark area, outside this the fundus is

lighter coloured, to become again of a darker brown as we near the ora serrata. There is a haze on the ciliary processes, which is more marked towards their posterior border. The lens is quite opaque and rather spermaceti-like in appearance; it is softish and comes away readily. The upper iris limb is wanting; the lower adheres to the cornea both at its centre and at its periphery. Microscopical sections show extreme inflammation of the episcleral tissue. The iris is much thickened by inflammatory cells, and has an exudation layer behind its uveal pigment. There is a conical plug of inflammatory cells in the centre of the optic papilla, with great multiplication of cells in the sheaths, and apparently also in the walls themselves of the blood-vessels of the papilla.

Case XLI.—*Sympathetic Inflammation occurring seven weeks after a Perforating Ciliary Wound of the other Eye. Excision of the Exciting Eye. Gradual Deterioration of Vision from persistence of Inflammation and Increased Tension. Temporary benefit from Sclerotomy.*

Edward J. T., æt. 31. Admitted August 12, 1879.

Right eye. Injured in May last by the bursting of a soda-water bottle. The sight of the *left* began to get dim seven weeks afterwards. *Right*: puckered cicatrix in ciliary region; globe shrunken. No perception of light.

Left. Slight ciliary blush. Minute dots arranged in a wedge shape on posterior aspect of cornea below. Pupil very sluggish, almost quite inactive to light. T.n., but rather low.

Right excised on admission. Ordered atropine drops for left.

26. Pupil dilated irregularly, but fairly well: it is a horizontal oval. T.n.

29. V. $= \frac{20}{70}$ c $-$ 12″ sph. $= \frac{20}{40}$.

Sept. 2. There is now slight conjunctivitis in left. Atropine discontinued. Astringent ordered.

18. Eye quiet. Very slight injection. Thin layer of lymph in pupil preventing accurate view of fundus. V. $= \frac{20}{40}$. Jaeger 1 at 10″. Discharged Sept. 23.

Re-admitted Oct. 17, 1879. Pupil nearly or quite excluded. V. very bad; can just see fingers, but not so as to count them correctly. T.n., or — T. 1? Ordered atropine drops and to wear black bandage.

25. Eye much quieter and less injected. Pupil dilating slightly.

29. V. $= \frac{20}{50}$. Slight injection. Iris somewhat *bombé*. T. 1? Discharged.

Re-admitted Dec. 22, 1879. The eye soon became painful after returning home, but this was relieved by leeching and blistering. Soon afterwards he had another attack, from which he is still suffering. The cornea is hazy. Pupil excluded and occluded. Iris atrophied and bulging locally down and out. Reads Jaeger 16. + T. 1? Ordered atropine drops. 27. Slight pain. T. + 1. 28. Much burning pain in forehead and eyeball. Lacrymation and great ciliary injection. Photophobia. T. + 2. Atropine discontinued; two leeches to left temple. 29. Pain was relieved by leeching. Has "neuralgia" in left temple and forehead. Hot water fomentations. Jan. 3, 1880. Eye much easier and sight better to-day. T.n. low. The bulging of iris below is now much smaller, and the globe is less injected. 4. Return of pain. T. + 1. Ordered eserine drops. 5. Severe pain early this morning, only slightly relieved by leeching, but much relieved by subcutaneous injection of morphia. 13. He has had several attacks of pain lately. T. + 1. Stop eserine. Feb. 3. T. + 2. Thinning of ciliary region above. Just counts fingers. 13. Sclerotomy upwards, of small size, but in good position. 14. Anterior chamber re-formed but shallow. — T. No bulging of iris now below. 19. Iris again bulging. Vision improved since sclerotomy. Reads Jaeger 16. 27. Iris brighter but still bulging. Eye much quieter. T.n. full. March 3. Keeps quiet. T. + 1. Discharged.

The further progress of this case could not be ascertained.

Pathological Examination.—The eye is shrunken. There is a puckered cicatrix at one side of the cornea extending into the ciliary body. The lips of the wound are much pulled in. On *antero-posterior section* the iris is seen to be firmly united to the edges of the wound. It has a thick white tough layer on its posterior surface. The retina is detached into an umbrella

shape. It is puckered up into deep longitudinal folds, and is firmly adherent to the fibrous plug which separates the lips of the wound and forms the scar tissue. No vitreous remains are visible in its small cavity. The choroid is *in situ*. Near the periphery its colour is darker brown than elsewhere, and rather irregularly intermixed with rather paler areas. *Microscopically* the iris is vastly thickened. It contains in its stroma numerous aggregations of inflammatory cells and a layer of connective tissue behind its thickened, much scattered, uveal pigment. The adventitia of its arteries is clear looking and very thick. The muscular structure of the ciliary body is pretty normal, but the connective tissue layer is thickened with inflammatory cells distributed as in the iris. The choroid is similarly thickened, but the groups of cells are found more particularly in its outer layers. The vitreous lamina bounding its internal surface is wrinkled. Colloid nodules appear to be present on it. The long ciliary nerves are normal, but some inflammatory cells surround the long ciliary arteries in their course through the sclerotic. The optic nerve presents some slight increase of nuclei near the disc, but its fibrous stroma is not hypertrophied.

Case XLII.—*Severe Iritis, presumably Sympathetic in Nature, occurring six years after loss of other Eye from Perforating Wound. Ultimate result unknown.*

Edmund R., æt. 72. Admitted March 21, 1877.

Left. Lost shrunken globe, result of perforating wound six years ago. *Right* has given no trouble until a week ago, when it became inflamed. Cornea nebulous above. Pupil small and drawn up; posterior synechiæ. Iris tissue infiltrated with lymph. Hyphæma. Bare perception of light.

Ordered atropine drops and belladonna fomentation. 24. Pupil not dilated. There is still blood in the anterior chamber. Very little pain. April 4, discharged.

Examined May, 1884. *Left*, much squared. No pain. *Right*, an iridectomy upwards has been done elsewhere. The pupil is drawn up to the scar. Bare perception of light. Tn. but rather low.

Case XLIII.—*Perforating Wound of Eyeball followed two months later by severe Sympathetic Inflammation leading to practically Complete Blindness.*

Sarah J. P., æt. 10. Admitted August 29, 1879.

The *right* eye was injured two years ago by a perforating wound with a pair of scissors. It is now shrunken, soft, and absolutely sightless. Dimness of sight began in the *left* eye two months after the above injury, and has got progressively worse since; the eye has been red and painful. There is now a large central nebula of cornea, seemingly the result of a past keratitis punctata; anterior chamber very shallow; pupil occluded and total posterior synechia; T. — . V. = hand-reflex barely. Discharged August 30.

In the following four cases the inflammation is very doubtfully sympathetic, but they were believed to be probably of this nature on admission.

Case XLIV.—*Shrunken Globe with Bony Degeneration following an old injury. Sympathetic Symptoms first observed about thirty years after the original Wound. Result favourable.*

James O., æt. 48. Admitted August 7, 1877.

Right eye lost from a wound with a stone 32 years ago. There is a puckered scar across the cornea. Globe much shrunken and squared. The *left* eye began to be dim-sighted about a year and a half ago. It has only once been painful, and that only for an hour or two, about two months ago. There is now recent marginal ulceration of the cornea at the outer and inner sides. Pupil small, irregular, and blocked: the outer side still acts slightly to light. Counts fingers at about 3 feet. 11. *Right* eye excised. 18. *Left.* Iridectomy upwards. 20. Anterior chamber nearly half full of blood. Sept. 5. Good coloboma. Lens cataractous. A little bright blood in bottom of anterior chamber. Counts fingers. Discharged.

Re-admitted, Nov. 2, 1877. Eye quiet. Has had pain in the eye lately but none now. Counts fingers at $2\frac{1}{2}$ feet. Discharged Nov. 3.

Re-admitted May 21, 1878. Much *in statu quo.* T. full. Vision much as before. Advised to return when sight is no longer of any use. Discharged May 25.

Pathological Examination.—Bony degeneration of choroid.

Case XLV.—*Old Corneal Ulceration in one Eye. Iridectomy twice for Leucoma and Secondary Glaucoma. Severe Pain following a Blow upon it some years later, and Iritis in other Eye. Excision of exciting Eye. Ultimate result excellent.*

John M., æt. 22. Admitted April 25, 1877.

Left eye injured about four years ago and removed on account of pain. The old notes are shortly as follows:— "Feb. 9, 1869. *Left* has been weak ever since measles in childhood. Iridectomy done three weeks ago. There is now a staphyloma of fourteen days' duration. Globe tense. Iridectomy done again. Feb. 11. Section united. Pupil clear." On Oct. 4, 1873: "*Left* large artificial coloboma up and in. Considerable patchy opacity of cornea. Lens clear. Large floating opacities in vitreous. Iris partially adherent to capsule of lens; remains of old iritic adhesions in coloboma. Fundus not visible. Has perception of large objects and projects correctly. The whole ciliary region appears thinned and of a bluish colour. No distinct staphylomatous bulging. Only slight pain at times until two months ago, when this eye was injured by a blow with a broom handle. Excised. Oct. 7. Discharged."

The *right* eye was inflamed (? corneal ulceration) a year before the injury to the *left*. Shortly afterwards it again became painful and inflamed. Present condition is as follows: — T. l. Iris thick and vascular; posterior synechiæ. Small marginal opacities on cornea and faint central nebula (no note of vision). Ordered belladonna fomentation, atropine drops, and blistering to temple. May 12. The pupil has dilated decidedly. V. has improved, now $= \frac{20}{70}$. Discharged.

Examined on Feb. 27, 1878. *Right*. No vascularity of iris. Eye feels easier. Posterior synechiæ except outwards. T.n. but low. Well marked ciliary atrophy. There is more or less mistiness as the light fails in the evening. V. $= \frac{20}{30}$ partly, with $-$ 40″ sph. $= \frac{20}{20}$ fairly. There is slight cupping of the optic disc well up to the margin, but no undermining.

Case XLVI.—*Left Globe Shrunken. Iritis in other Eye several years after loss of Vision in Right. Duboisine delirium. Result good.*

Robert H. S., æt. 51. Admitted May 12, 1879.

The *left* eye was never of much use; the sight left it entirely in 1871, and the globe then began to shrink. It has never been painful.

The *right* eye had "glaucoma" in April, 1871, but no iridectomy was done, as the eye meanwhile recovered spontaneously. His V. then was $= \frac{20}{30}$ without correction (from out-patient notes). The eye has continued well ever since till eight days ago, when it became bloodshot and painful, with dimness of sight.

He is a healthy-looking man; dark hair and complexion. He is subject to articular rheumatism, but there is no family history of joint or eye affection.

Left eye. Shrunken squared stump. *Right* eye. Conjunctival and ciliary injection. Arcus senilis above. Pupil rather sluggish; dilates eccentrically but evenly under daturine, exposing spots of uvea on the anterior lens capsule; vitreous clear. O.D. slightly excavated with small crescent at outer side. V. $= \frac{20}{200}$ c $- 30'' = \frac{20}{40}$ and $\frac{20}{30}$ partly. Colour perception good. T.n.

13. *Left* excised. Ordered atropine to right, and dark bandage. 18. Last evening he raised his bandage for a moment to see and found his sight very good. Since then he has had severe pain across the forehead and round the head. The sight is more dim. + T. 1? Sees coruscations, &c.; to use duboisine instead of atropine drops. 19. T.n. Sight quite clear again. Pain all gone except a little in occipital region. 23. Since using duboisine he has had optical illusions, "strange looking animals sitting on the top of chairs piled one on another." June 2. R.V. $= \frac{20}{30}$ fairly, c $- 80'' - \frac{20}{20}$ fairly. There is a circle of uvea-dots on anterior capsule corresponding to old pupil. T.n. Discharged.

XLVII.—*One Eye injured by Chip of Steel; Affection of second Eye some months later. Restoration of useful Vision in second Eye after Extraction of the Lens. The injured Globe ultimately lost and excised.*

John S., æt. 38. Admitted September 25, 1879.

Left eye. Injured by piece of steel about 20 years ago. The sight has never been so good since as it was before this accident; "the pupil was drawn in a sort of oblong." Some months later the sight of the *right* became affected, and this eye was operated on elsewhere 17 years ago, the lens being removed. No history of syphilis, rheumatism, or gout.

R.E. Small black pupil; lens absent. T.n. V. c + 10 D. = $\frac{20}{200}$, and c − 11 D. reads J. 10 at 12″.

L.E. Pupil eccentric, closed and occluded. Iris *bombé*. V. = hand-reflex well. T.n.

26. L.E. Iridectomy attempted up and in; iris very rotten, and none could be obtained. October 7. L.E. Conjunctival injection. — T. 1? Excised.

Pathological Examination.—The globe of normal size, its measurements being,—antero-posterior, 25 mm.; lateral, 25 mm.; vertical, 24·5 mm. Its tension is normal. The cornea is clear, the anterior chamber extremely shallow at best, but obliterated entirely over two areas—one to the upper and outer, and the other to the lower and outer side. The iris is adherent to the cornea at the margins of each of these areas by several felty looking points. Indeed, this felty appearance of the iris is general, that is to say, its structural details cannot be recognised. The colour is grey mottled irregularly with much darker spots. A minute dark central spot marks the position of the closed pupil. Near the lower and inner margin of the cornea are two little apertures, as if the iris fibres were torn apart here. *Equatorial Section.*—The clear and slightly solidified vitreous is seen to be somewhat shrunken towards its anterior attachments. Between it and the retina, which is *in situ*, is rather thin fluid. The optic disc is distinctly swollen and slightly hazy. The lens is *in situ*; its nucleus is brown and cataractous; its anterior capsule presents several whitish-grey patchy areas, apparently the results of posterior synechiæ. The ciliary processes are very slightly

greyish from a fluffy deposit on their internal surface; otherwise they look normal.

General Summary.*

I. *Age.*

The age of the patient at the onset of the sympathetic disease is here meant.

The youngest was aged 4 years, the oldest 79 years.

Table I.

Giving the Number of Cases met with occurring in each Decade of Life, and the percentage in each Decade of the total number resulting from Injury.

	From perforating injury.	From operation.	From other causes.	Total.
Under 10 years.....	5 or 20 p. c.	1	..	6
10 to 15 „ = 3	4 „ 16 „	1	1	6
15 „ 20 „ = 3				
20 „ 30 „	4 „ 16 „	..	1	5
30 „ 40 „	3 „ 12 „	..	2	5
40 „ 50 „	5 „ 20 „	..	..	5
50 „ 60 „	2 „ 8 „	4	1	7
60 „ 70 „	2 „ 8 „	4	..	6
70 „ 80 „	1 „ 4 „	2	..	3

There is here a remarkable similarity in the number of cases occurring in the different decades, and, although from such comparatively small numbers we must draw statistical conclusions with much caution, we may infer that those advanced in life are at least as liable to this affection as the young. Indeed, if we consider the total number of persons living at different ages,† the numbers given in this table would favour the view of greater relative liability in advanced life. This is a question of

* In the following examination of the above recorded cases, those that were considered doubtful in their sympathetic nature (Nos. 44—47) will not be included except when specially mentioned.

† *See* Farr's Vital Statistics, 1885, pp. 467–8, where Decennial Tables are given for the London districts of Hanover Square and Whitechapel.

some importance, in as far as it has been repeatedly asserted that children are more subject to sympathetic ophthalmitis than adults.

With the view of investigating this matter of liability according to age, I have collected all the cases of accidental perforating injury admitted as in-patients at Moorfields during the same period (a little over three years) in which the sympathetic cases came under treatment. By "recent" cases (see below) I mean only such as were admitted within a fortnight after the injury; they were consequently serious enough for admission from the mere severity of the injury, and not, except perhaps very exceptionally, from any complication. From these statistics we may form an idea of the relative number of cases of severe perforating injury *liable to be met with* at different ages.

TABLE II.

Showing all Cases of Perforating Injury met with, arranged according to the different Decades of Life in which they occurred, and giving the relative percentage in each Decade.

	Recent perforating injuries.		Total perforating injuries.	
Under 10 years	41 or about 20 p. c.		88 or about 23 p. c.	
10 to 15 "	46 { 22 " 10½ " } 22 p.c.		85 { 46 " 12 " } 22 p.c.	
15 " 20 "	{ 24 " 11½ " }		{ 39 " 10 " }	
20 " 30 "	47 " 23 "		80 " 20½ "	
30 " 40 "	39 " 19 "		62 " 16 "	
40 " 50 "	16 " 7½ "		36 " 9 "	
50 " 60 "	12 " 6 "		23 " 6 "	
60 " 70 "	3 " 1½ "		8 " 2½ "	
70 " 80 "	2 " 1 "		3 " 0¾ "	

It will be seen—and this holds good even after correction for the much diminished number of persons living at more advanced ages—that accidents of this nature are most apt to occur before forty years of age. This extra liability is fully accounted for by exceptional exposure during a great part of this period; in childhood the care-

lessness or awkwardness of companions ranks as a fruitful source of such accidents.

If we now compare with Table II the figures in the first column of Table I, where the numbers of cases of sympathetic inflammation at different ages due to perforating injury are given, we get (so far as these statistics can give it) some knowledge of the proportionate liability to the occurrence of sympathetic disease after such injury in the different decades of life.

TABLE III.*

Giving the Proportionate Relation of Sympathetic Inflammation from Injury to the number of Cases of Injury met with at different Ages.

	To recent cases.	To total number of perforating injuries.
Under 10 years...	About $12\frac{1}{2}$ p. c.	About $5\frac{3}{4}$ p. c.
10 to 15 ,, ...	,, 9 ,, } $8\frac{3}{4}$ p. c.	,, $4\frac{1}{2}$,, } $4\frac{3}{4}$ p. c.
15 ,, 20 ,, ...	,, $8\frac{1}{2}$,,	,, 5 ,,
20 ,, 30 ,, ...	,, $8\frac{1}{2}$,,	,, 5 ,,
30 ,, 40 ,, ...	,, $7\frac{3}{4}$,,	,, $4\frac{3}{4}$,,
40 ,, 50 ,, ...	,, 31 ,,	,, 14 ,,
50 ,, 60 ,, ...	,, $16\frac{1}{2}$,,	,, $8\frac{3}{4}$,,
60 ,, 70 ,, ...	,, 66 ,,	,, 25 ,,
70 ,, 80 ,, ...	,, 50 ,,	,, 33 ,,

The relatively high percentage of sympathetic inflammation after accidental injury in advanced life met with at Moorfields during this period is doubtless due, in great measure at least, to an exceptional series of cases. We must also bear in mind that older people are more inclined to stay at home after an accident than younger, and generally only come to hospitals if compelled to do so by the onset of severe pain or other complication. This latter fact must falsify all hospital statistics of this or

* In all these tables I have subdivided the decade 10 to 20 to see whether there was any marked difference in liability in the five years before and after the average age of puberty. It will be seen that no such difference is shown.

kindred nature.* Making every allowance, however, for such causes of fallacy, the impression left with us is that there is no just foundation for the common opinion that the young are especially subject to get sympathetic disease from injury.

How far age was found to determine the severity of the inflammation and the rapidity of its occurrence will be considered later.

II. *Nature of the Primary Affection of the Exciting Eye.*

A. *Accidental Wounds.*—In six cases the cornea was the only external coat penetrated, but the iris appears always to have been involved, either being actually wounded or by becoming prolapsed. In six cases the ciliary region was wounded, and in three others it was ruptured by a blow with a blunt instrument. In one the sclerotic alone was wounded. In eleven the site of the wound is not mentioned; but, from the nature of the accident, the anterior part of the eye was penetrated in every instance.

Very various instruments were the causes of these injuries. In four cases the eye was ruptured by a blunt body (cow's horn, fist, boot, candlestick); in three the eye was penetrated by a piece of metal flying off while at work, and in one of these it remained in the globe; in two it was cut by children's toys (tip-cat and flying top); in two by the bursting of aërated water bottles; in one by gun-shot; in three by sharp pieces of wood. Among the other instruments we find a table-fork, knife, pair of scissors, steel umbrella rib, door latch, corn rake, &c. In one case the injury was said to have been inflicted by a large hailstone.

B. *Operations.*—In six cases the operation performed was cataract extraction; in three of these the incision was the original linear one recommended by von Graefe,

* This source of fallacy is pointed out by Priestley Smith "On Primary Glaucoma in Relation to Age," Trans. Ophth. Soc., vol. vi, p. 305.

in the remainder a modified linear incision. In two other cases the sympathetic inflammation seemed due to needling opaque membrane after removal of cataract, rather than to the extraction itself. In all these cases either the iris was adherent to the cicatrix, or severe inflammation implicating the iris occurred during the after-treatment; in two of these there was panophthalmitis, and in another much shrinking of the exciting eye before the outbreak of sympathetic inflammation. Of the remaining operation cases, one was iridectomy for increased tension in a case of corneal ulcer; one iridodesis for artificial pupil in lamellar cataract; one Saemisch section for corneal abscess (followed by prolapse of iris); and one trephining a dense corneal leucoma in a partially shrunken eye.

C. *Other Causes.*—In four cases the exciting eye was damaged by old corneal ulceration; in the only other case the eye was lost from inflammation "following a poisoned wound by fly-bite."

III. *Interval.**

A. *Short.*—All cases occurring within the first month may be included here.

The shortest interval observed was one of about 14 days (Case 8), and there is considerable doubt as to the exact period here. It was a case of cataract extraction, followed by needling, in which at the time of the secondary operation, nothing was observed amiss with the other eye.

In three cases there was an interval of 3 weeks, and in one case of 24 days. It may be remarked here that in four of these five cases, with short interval, the result as regards the sympathiser was exceedingly bad.

* By *interval* is here meant the time elapsing between the primary affection of the exciter and the onset of sympathetic inflammation. The division into short, moderate, and long intervals is the same as that adopted by the Committee on Sympathetic Ophthalmitis. *See* their Report in Trans. Ophth. Soc., vol. vi, p. 170.

In Cases 24 and 26 sympathetic inflammation commenced a few days after a second injury, but in both the primary injury would seem to have been the real cause of the disease.

B. *Moderate.*—In this category I have placed all cases in which the interval was at least one month and not more than one year.

Interval =	1 month	in 1 case.	
„ =	5 weeks	„ 1 „	
„ =	6 „	„ 2 cases.	
„ =	7 „	„ 2 „	
„ =	2 months	„ 4 „	
„ =	2½ „	„ 5 „	
„ =	3 „	„ 6 „	
„ =	4 „	„ 4 „	
„ =	5½ „	„ 1 case.	Blow on eye lost from old inflammation.
„ =	8 „	„ 1 „	In this case the interval was doubtful; possibly shorter than here stated.
„ =	10 „	„ 1 „	

The liability to sympathetic inflammation would thus appear to be at its maximum between the 2nd and 4th months after the primary affection of the exciting eye.

C. *Long* (or more than one year).—In Cases 2, 20, 23, 29, 33, 37, 38, 42 the exciting eye was damaged by injury. In one of these (33) the interval was exceedingly long, viz., 30 years or more, but the exciting eye had been occasionally painful for 18 months before the onset of sympathetic symptoms. The choroid of the excised eye had undergone bony degeneration, and a layer of pus (?) is said to have been found on its inner surface. Although no inflammation was noted at this date, it is possible that a careful examination might have shown minute dots on Descemet's membrane, or traces of iritis. The latter seems never to have been acute, as there was no history of attacks of severe pain. No history of rheumatism or gout could be obtained when in hospital, but during the past year (1886) he has had pain in his insteps and legs.

The next longest interval was one of 20 years (Case 37), and there was no recent pain or redness in the shrunken

exciting eye: there is little doubt as to the true sympathetic nature of the inflammation here. In Case 23, 11 years elapsed between the injury and inflammation of the second eye; but here there is a history of the sympathiser having been irritated by a small foreign body just before the outburst. In two cases (38, 42) there was an interval of six years, and in neither is there any note of the exciting eye having been recently affected. In Case 29 there was an interval of two years. In the remaining two cases (2, 20) the interval was $2\frac{1}{2}$ and two years respectively: in the former the exciter had been inflamed and painful for some months before the second eye suffered.

In two cases of very long interval the exciter was lost from corneal ulceration. In one of these (Case 4) the interval was 39 years, and the exciter does not appear to have been recently inflamed. In the other (Case 15) the exciter had been painful shortly before the sympathetic symptoms commenced, the interval reckoning from the corneal ulcer being 23 years. Both cases were alike in there being keratitis punctata, with little or no pain in the sympathising eye.

Relation of Interval to Age at Date of Sympathetic Disease.

The following table deals with much too small a number of cases to be in itself even suggestive, but it may be of service to anyone dealing with similar statistics on a large scale. We are manifestly, other things being equal, more liable to get cases with a long interval as age increases, and we might perhaps expect the shortest intervals in childhood when tissue-changes in general are most active. The table would rather support the latter expectation, and we find that the longest intervals occurred at a time of life when increased liability from age had not been counteracted by the decrease in the actual number of persons living. Again, in the aged the nature of the primary lesion in the exciter may mainly determine the interval, the great majority being from cataract extraction.

TABLE IV.

Giving Length of Interval in different Decades of Life.

	Short.	Moderate.	Long.
Under 10 years	2	4	
10 to 20 „	..	6	
20 „ 30 „	1	..	4
30 „ 40 „	1	3	1
40 „ 50 „	..	2	3
50 „ 60 „	..	7	
60 „ 70 „	1	4	1
70 „ 80 „	..	2	1

Relation of Interval to the Nature of the Primary Affection of the Exciter.

TABLE V.

	Short.	Moderate.	Long.
Accidental wounds	4	14	8
Operations	1	11	..
Corneal ulceration	..	2	2

Of cases where the exciter had been lost or impaired by corneal ulceration, the sympathising eye was affected very late in two. It may be objected in such cases that the inflammation in the second eye was not proved to be truly sympathetic in nature, but in those given here it was very similar in character at least to the sympathetic form.

In regard to operations, the only case in which the interval was short was the somewhat doubtful one already referred to, where sympathetic inflammation came on a fortnight after needling, and $2\frac{1}{2}$ months after cataract extraction. In none of the operation cases was the interval long. So many of these operations were done for extraction of senile cataract, that age is presumably a factor in determining the length of interval. The interval in the

case of injuries varied exceedingly, and was probably influenced, here as elsewhere, not only by the age of the patient, the character of the injury (*e.g.*, its exact site, nature, and condition of instrument), but also by the treatment adopted subsequently (as regards avoidance of exposure to bright light or cold), by the patient's state of health, his natural predisposition to iritis, &c.

IV. *Character of the Sympathetic Inflammation.*

All the cases are here arranged in three groups, according as to whether the inflammation was *mild*, *moderate*, or *severe*.

A. In five instances (Cases 4, 6, 11, 22, 24) the attack may be said to have been distinctly *mild*. In all of them the disease ran a short course without any very urgent subjective symptoms, and there was no relapse. Locally there was slight ciliary injection: posterior synechiæ were formed in all, but the pupil dilated well under atropine, except in Case 6, where one synechia persisted. (This latter case, indeed, was altogether more severe in type than the other four included here, though considerably milder than those in the next group.) Keratitis punctata was noted in only two of them, but possibly occurred more frequently, as the cornea was not then so carefully examined as is now the custom. It may be noted that in *all* of them the exciting eye was excised soon *after* the outbreak of the disease in the sympathiser.

B. In more than one-half the total number of cases the inflammation was *moderate* in intensity. The general characters of the affection in such cases are these:—The attack is somewhat prolonged, with a marked tendency to relapses, or at least remissions. The sympathising eye is not rapidly rendered sightless, but tends to deteriorate with each fresh exacerbation of the disease. The pain is rarely very acute, and is then generally relieved by leeching or other simple treatment. The local symptoms vary considerably in different cases, especially as to the

amount of ciliary injection and tenderness and of iritic infiltration. Keratitis punctata is usually well marked, if indeed not universal in cases of this type.

As will be seen subsequently, in at least half the 24 cases coming into the group, the inflammation, although moderate in intensity, ultimately led to loss of the eye.

C. In 14 cases (1, 2, 3, 5, 7, 16, 18, 23, 28, 30, 32, 34, 40, 42) the inflammation was acute and very *severe*, accompanied frequently by great intractable pain, and leading rapidly to loss of sight in the sympathising eye. In the most severe cases of all I do not think that keratitis punctata is by any means constant.

The relationship between the character of the inflammation and age, interval, &c., will be considered under the next heading, viz. :—

V. *Final Condition of Sympathising Eye.**

The final condition is here spoken of as *good* when the eye retained at least two-thirds of normal vision ; *moderate* when it was still an useful organ in guidance, and could decipher at least the larger of Jaeger's test-types; *bad* when it could at most only distinguish light from darkness.

A. *Good.*—The five cases under this heading we have already cited as examples of a *mild* type of inflammation; there can, I think, be no doubt as to their true sympathetic nature. In only one of them was the ultimate vision less than $\frac{20}{20}$ partly, the exception being the case previously referred to as having a persistent posterior synechia.

B. *Moderate.*—There are twelve instances of this final condition, viz., Cases 10, 13, 17, 20, 21, 25, 26, 27, 31, 33,

* In order to ascertain the ultimate result, the patients have, when possible, been kept under observation. Unfortunately, however, several of them ceased to attend, and could not be afterwards traced ; others left their old homes, and were obliged to become inmates of workhouses, and could not always come to hospital when sent for.

37, 41. In five of these the patients were only a short time under observation.

C. *Bad.*—In no fewer than 25 cases the sympathising eye is known to have been rendered useless by the inflammation, and in another case (42) the result was doubtless similar, though it was not ascertained with certainty. All light-perception was lost in this eye in nine instances (Cases 1, 7, 8, 15, 18, 19, 30, 34, 40), and the globe was excised in six of these.

From the after-history obtained in some cases it is probable that the ultimate result was bad in several of those here classed as *moderate*, but which were lost sight of. In 12 of the 24 cases in which the inflammation was moderate in severity, the final result was bad. A progressive deterioration is noticeable particularly in Cases 9, 15, 19, 34, 36, and 38. Our prognosis must therefore be a guarded one in all cases of moderate severity. Sometimes the deterioration has been largely or entirely due to changes in the lens subsequent to the sympathetic attack; in such cases the vision may frequently be improved by operation if the tension of the globe has remained good.

Relation of Character of Inflammation and Final Condition to Age at Date of Sympathetic Disease.

TABLE VI.

Giving the Character of the Inflammation and the Result in the Sympathising Eye in different Decades of Life.

Age.	A. Mild or Good.		B. Moderate.		C. Severe or Bad.	
	Inflammation.	Result.	Inflammation.	Result.	Inflammation.	Result.
Under 10	..	..	6	3	..	3
10 to 20	..	..	5	2	1	4
20 „ 30.....	..	..	2	..	3	5
30 „ 40.....	2	2	1	1	2	2
40 „ 50.....	1	1	4	4	..	..
50 „ 60.....	2	2	2	1	3	4
60 „ 70.....	..	..	4	1	2	5
70 „ 80.....	..	..	..	..	3	3

The tendency to a severe type of inflammation and an unfavourable result would thus appear to be greater at the extremes of life, but the statistics as regards the aged are modified by the nature of the primary affection of the exciting eye (see following table). The fallacy previously noticed, viz., the tendency of old people to avoid coming to hospital if possible, does not apply so forcibly here, as all cases of cataract extraction had to return for glasses, or for subsequent operation.

Relation of Character of Inflammation and Final Condition in Sympathising Eye to Nature of Primary Affection of Exciter.

TABLE VII.

	A. Mild or Good.		B. Moderate.		C. Severe or Bad.	
	Inflammation.	Result.	Inflammation.	Result.	Inflammation.	Result.
Accidental wounds	3	3	18	9	5	14
Operations ...	1	1	3	2	8	9
Corneal ulceration, &c.	1	1	3	1	1	3

The type of inflammation was thus relatively very severe after operations. Eight of these followed extraction of senile cataract (two of them after a subsequent needling), and in seven of these the result was bad. How far this high percentage of severity was due to the nature of the operation, and how far to a presumably unfavourable predisposition from age, it is impossible to determine from these cases.

As regards the accidental wounds, mere position of injury did not seem to influence the character of the inflammation or the result; wounds of the ciliary region had as low a percentage of severity as those confined to

the cornea with implication of iris. Similarly, the nature of the instrument appeared to make no difference in this respect.

Relation of Character of Inflammation and Final Condition to Interval.

Table VIII.

Interval.	A. Mild or Good.		B. Moderate.		C. Severe or Bad.	
	Inflammation.	Result.	Inflammation.	Result.	Inflammation.	Result.
Short.....	..	..	3	1	2	4
Moderate	4	4	15	8	11	18
Long.....	1	1	6	3	1	4

The interval appears to have little or no relation with the severity of the disease in these cases; perhaps the tendency to a bad result may be said to have been rather greater with a short than with a moderate or long one.

V. *Final Condition of Exciting Eye.*

In 34 cases the exciting eye was lost, and in 30 of these it was excised, either on account of pain in itself or sympathetic affection in its fellow. Where the exciter, although lost, was quiet, and the other eye not in a position likely to be benefited by the operation, it was not excised. In three cases (22, 24, 34) the exciter, although not really lost, was excised; in two of these its fellow was already inflamed before the excision, yet ultimately recovered excellent vision; in the remaining case the exciter was removed for sympathetic *irritation*, but subsequently violent ophthalmitis set in and caused the loss of the sympathiser.

In six cases (8, 9, 10, 18, 30, 40) the exciting eye retained useful vision, although the sympathiser was lost

in five of them and greatly damaged in the sixth. In four of these the primary lesion in the exciter was cataract extraction (Cases 8, 18, 30, 40), and it is remarkable to note how quiet this eye remained while the sympathiser was passing through a severe inflammation; in all four the latter was absolutely lost, and had to be enucleated on account of pain. In one of these patients V. $= \frac{20}{30}$ and Jaeger 10, in another $= \frac{20}{40}$ and Jaeger 1 when corrected; in the others the exciter had been much damaged by iritis previously to the sympathetic attack, so that they had respectively only V. $= \frac{20}{100}$ and Jaeger 10, and $\frac{20}{200}$ and Jaeger 16. In Cases 9 and 10 the exciter was injured by accidental perforating wound; and, though it was inflamed rather severely along with its fellow, it was in neither case painful, so that the surgeon wisely forebore to excise it. In the one case it ultimately could read words of Jaeger 1, and in the other counted fingers at 7 feet. In all the cases in which the inflammation was severe in the sympathiser the exciter was lost, with the exception of four (Cases 8, 18, 30, 40); in two of these the final condition was excellent $\left(\frac{20}{30} \text{ and } \frac{20}{40}\right)$. In four of the five cases of mild inflammation the exciter was lost, the exception being Case 22. In all these, however, the exciter was excised, as has already been remarked.

In three cases (12, 16, 28), and probably in a fourth (27), the exciter was lost from panophthalmitis, and in all the sympathising eye suffered severely.

VI. *Effects of Treatment.*

All those treated in the acute stage had *atropine* instilled several times daily with the exception of Case 2. In this instance the exciter had previously been operated on for glaucoma, and atropine was presumed to be therefore

contra-indicated as the inflammation was of a mild type; there was keratitis punctata with dots of lymph deposited at the pupillary edge, but no firm posterior synechiæ were formed, and vision was normal at the last examination.

A *dark* silk *bandage* was invariably worn during the inflammatory stage. *Leeching* was employed for the relief of pain, and, when this did not suffice, *morphia* was injected subcutaneously into the temple.

Mercury, pushed to mild salivation, was used in thirteen cases, including two of a mild, eight of a moderate, and three of a severe type. In both the mild and in several of the moderate cases it seemed to be of some service.

Operations.—In eleven cases *iridectomy* was performed on the sympathising eye. The details were shortly as follows:—

Case 2. Iridectomy at about the fourth week after outbreak, T. being +2. Followed by temporary relief of pain and by normal tension, but the sympathetic inflammation continued to run a very severe course.

Case 5. At the end of the third month, T. being +2, iridectomy was attempted, but no iris obtained: followed by normal tension but no improvement. Two months later the lens was removed and a piece of iris excised (see fuller account of this operation at p. 85); lymph afterwards gradually filled the coloboma. Eight months later (more than a year after commencement of inflammation), the eye then having T. −2, another iridectomy was done, a very little iris being obtained piecemeal. No improvement from any operation.

Case 8. Iridectomy at the end of the third month, a small piece only obtained; pain more severe afterwards. Nearly nine months later (about a year after outbreak), while T.n., another iridectomy done, leaving a good coloboma, with very considerable improvement in vision.

Case 12. Iridectomy about one year after outbreak, T. being +1; iris friable, and only small piece obtained; doubtful improvement. About two years and a half later,

a second iridectomy done; vision improved. About three and a half years again later, T. being + ?, the lens was extracted; followed by iritis and deterioration of vision.

Case 15. About nine months after outbreak, T. being + 1 with ciliary staphylomata, the entire iris and part of the lens were removed: the staphylomata thereupon flattened and T. became −. Eye subsequently shrunk, and sight was quite lost.

Case 20. About fifteen years after outbreak, eye being again inflamed and T. normal or + ?, iridectomy was done; improvement in condition of iris and also slight in vision.

Case 21 (Lamellar Cataract). About four years after outbreak, T. being +1?, iridectomy; vision improved. Nearly five months later the lens was extracted with fairly good result.

Case 27. Iridectomy nine days after outbreak, a good coloboma being obtained; severe pain a few days later. About three months later, T. being +1, curette extraction of cataractous lens; T. soon became −1?, V. temporarily improved. Nearly three months later, T. being − 1?, Weiss' scissors used to divide lymph in coloboma; marked improvement in vision.

Case 32. Five years after outbreak, T. being +2, iridectomy done and a little iris removed piecemeal; T. became normal, but vision was not improved.

Case 33. Iridectomy about twenty years after outbreak, and good coloboma left. Two months later, T. being normal, cataractous lens removed, but soft matter left behind; gradual absorption and improvement in vision. Four months later, T. being normal, iridectomy done, a large piece being obtained with Tyrrell's hook; no further improvement in vision.

Case 40. About one month after outbreak, T. being + 2, iridectomy done; no improvement. About three months later, corneal section (Saemisch) through onyx that had formed; much pain necessitating excision of globe.

Case 42. Iridectomy at another hospital; date and other facts not obtained. Result not favourable.

In one case (10) iridectomy was done on the *exciter* five months after the commencement of the sympathetic inflammation; no improvement in vision, but eye not manifestly worse.

Sclerotomy was performed on the sympathising eye in two cases for relief of tension:—

Case 34. Five months after outbreak, T. being +1; relief of +T. and of pain. The eye subsequently became blind and shrunk.

Case 41. About seven months after outbreak, T. being +2, sclerotomy; temporary improvement in tension and in vision.

Other operations on the sympathising eye were only performed in two instances:—

In Case 18, about ten months after the outbreak, T. being normal, the iris and shrunken lens were divided with Weiss' scissors at the level of the pupil, with considerable loss of fluid vitreous; marked improvement in vision resulted.

In Case 1, paracentesis was done repeatedly with a broad needle through ciliary staphylomata to reduce +T.; pain seemed to be relieved temporarily by each operation.

As a result of the above analysis I should conclude—

(1.) That it is well to employ mercurials in all cases during the acute stage from the commencement.

(2.) That when and while the inflammation is of a very severe type treatment should merely be palliative, and no operative measures are warrantable.

(3.) That cases of moderate severity are best left alone (*i.e.*, without operation) for the first six months at least, but iridectomy may be then attempted if the tension is plus and the iris *bombé*. If at the end of a year the tension is about normal, but the pupil excluded and occluded, improvement may be expected from a large

iridectomy (when possible) with extraction of the lens, followed later by division of the lymph and opaque membrane with Weiss' scissors. Or the latter instrument may be used alone, part of the lens-substance being removed at the same time, and the rest left to absorption or subsequent curette evacuation if necessary.

VII. *Occurrence of Sympathetic Ophthalmitis after Excision.*

The onset of the disease was first observed subsequently to excision of the exciter in four cases (12, 33, 34, 35).

A very mild form of inflammation is, however, apt to be overlooked; and this was still more the case before our present more accurate method of examination with a high + lens behind the ophthalmoscopic mirror was introduced.* Case 36 is instructive in showing how easily a fallacy may occur from a severe relapse being mistaken for a first onset. Unfortunately none of the instances here given is beyond suspicion, with the exception perhaps of Case 34, and in it there is another source of fallacy in that the patient had a history of rheumatism.

In Case 12, according to the in-patient notes in 1869, the sympathising eye was unaffected at the date of excision of the exciter, and does not appear to have suffered for at least four days afterwards, as during this period the patient remained in hospital. The outbreak, however, probably occurred within a week after the excision at farthest, as the iritis was well developed on the eleventh day.

In Case 33 there is considerable doubt as to the sympathetic inflammation having really commenced after excision, but sympathetic "irritation" is alone mentioned in the notes of this date (1864). Subsequently the case seems to have been one of moderately severe sympathetic inflammation, probably with marked keratitis punctata, as a corneal nebula remained without any history of a previous corneal ulceration.

* As examples of a very mild form of the disease, *see* the cases detailed by Milles, Trans. Ophth. Soc., vol. iii, p. 60.

In Case 35 there was well-marked sympathetic irritation at the time of excision. Next day there was conjunctivitis, and five days later ciliary injection, the pupil being still active, though oscillatory. It was not till four weeks after the excision that pain commenced and iritis was noted; he was under observation as an in-patient during the whole time. It must be observed that he was a rheumatic subject, and that the inflammation was at first of this type, but later it acquired more of the usual sympathetic character, ultimately leading to a bad result.

In Case 35 the date of the occurrence of the sympathetic ophthalmitis is dependent on the accuracy of the history given by the patient's parents, as the injured globe was excised at another hospital. From the statement thus obtained the second eye would seem to have been first affected "shortly after" excision.

VIII. *Miscellaneous Remarks.*

(*a.*) The history of the nature of the inflammation from which the exciter was lost is very imperfect in Case 3. Supposing it to have been a poisoned wound, as the patient stated, it is possible that a localised meningitis may have been the cause of the affection of the portio dura and auditory nerves on the same side.

(*b.*) The exciting eye was lost from *panophthalmitis* in three of the cases, viz., 12, 16, 28.

(*c.*) In several of the cases there was shooting pain complained of comparatively early in the affection, beginning on the side of the exciting eye and travelling across the forehead to the opposite eyeball and temple. This is by no means an uncommon history in sympathetic inflammation. (*See* Cases 16 and 32.)

(*d.*) The frequent recurrence of keratitis punctata in Case 25 is noteworthy. Previous to excision, attacks used to occur about twice in the year. Shortly after excision there was an attack, another about a year later, then others at intervals of two years, three years, three years again, and

one year. Though of moderate severity, the more recent attacks do not appear to have led to much deterioration of vision.

(*e.*) As noted in Case 34, the pupil of the sympathising eye was oscillatory previously to the outbreak of the inflammation. This symptom of marked oscillation or *jumping* is common in cases of sympathetic irritation, and I believe that in some instances it is the most prominent warning present, the other usual symptoms (photophobia, lacrymation, &c.) being absent or slightly developed. The mode of examination required is the same as that employed in testing the activity of the pupil to light; and the exposure once made is kept up while the observation lasts. Where oscillation occurs, the pupil, after responding promptly to the light-stimulus, almost immediately dilates again, then contracts nearly as much as before, then dilates wider, and continues thus to alternate, every now and again an especially wide dilatation being reached; the interval between the oscillations varies from between about a second to one-fourth of a second. Minor degrees of this wavy condition of pupil are comparatively common in cases of asthenopia, especially when due to hypermetropia or hypermetropic astigmatism, and also in persons of an excitable nervous temperament; but I have never observed in such cases the extreme oscillations occasionally met with in sympathetic irritation.

In this same case (34) the patient complained of intense headache and morning sickness, and I regret that his optic discs were not examined then, as the symptoms are precisely those so commonly met with in cases of intracranial disease associated with optic neuritis.

(*f.*) In at least two of the cases (36, 40) the lymphatic glands of the cheek or neck became swollen during the ophthalmitis.

(*g.*) In one case (29) the iritis was accompanied by pus in the anterior chamber, a comparatively rare association in sympathetic inflammation.

Doubtful Cases.

It may be urged that the recording of doubtful cases is unnecessary. It is clearly injudicious, however, to reject all cases except such as conform strictly with our previously formed notions of this disease, and these were all sufficiently like to be judged sympathetic on first admission. It is from doubtful cases, indeed, that we sometimes learn exceptional facts which may perhaps enable us reasonably to modify our views concerning the disease under consideration. Care must, however, of course be taken not to lay too much stress upon such cases, and I have therefore not included them in the previous remarks.

Case 44. The interval here is a very long one, but the condition of the lost eye is similar to what we not infrequently find in an exciter of the disease after a long interval. Though there was corneal ulceration, the iritis was apparently older in date. It is intelligible, too, that the nutritional changes consequent upon an irido-cyclitis may predispose to corneal suppuration; we have an instance of such an association in Case 40 given above.

Case 45. In this case the sympathiser would seem to have suffered from a previous corneal ulceration, but the condition of the iris on examination was very suspicious of a recent iritis of the usual sympathetic type, and the attack would seem to have followed the blow causing pain in the exciter.

Case 46. This appears to have been probably a case of rheumatic iritis. The history of the attack in the left eye is very imperfect, but would suggest corneal ulceration in childhood, followed by irido-cyclitis (? rheumatic) in late middle life. The attack of so-called "glaucoma" in the right was probably a first attack of iritis in this eye. This patient had well-marked duboisine delirium.

Case 47. There is little doubt as to the sympathetic nature of the affection in this instance, but the details are meagre. The sympathetic inflammation seems to have

commenced a few months after the injury to the exciter, and apparently ran rather a severe course, probably leading to complete blocking of the pupil. It was judged necessary to remove the lens from the sympathising eye three years later, and a moderately good pupil was obtained with useful vision.

CURATOR'S PATHOLOGICAL REPORT.

By J. B. Lawford, F.R.C.S.

Cases of Dislocation of Crystalline Lens.

Case I (*Reg. No.* 1733).—*Dislocation of Lens: Secondary Glaucoma with intercurrent attacks of pain; Retinal Hæmorrhages; Changes in Optic Nerve.*

Male, æt. 62. Blow on left eye by piece of wood twelve months before admission. Sight failed very rapidly, and in one month after accident, eye was blind. During that time he had severe pain, and has been subject to short similar attacks ever since. On admission, Right eye healthy; Left, slight ciliary injection; cornea, hazy; pupil, dilated and inactive; no p. l.; T. + 3.

Left eye excised: examined at once.

Cornea of normal appearance, except that there is some loss of transparency. *A. C.* of moderate depth, but encroached upon by adhesion of iris to cornea at periphery, especially on temporal side. *Lens*, which is clear, is displaced downwards and outwards, and rests against ciliary processes at that part; the suspensory ligament has given way at other parts of circumference of lens, so that its upper edge is freely movable when eyeball is moved. The *iris* and *ciliary processes* are atrophied; the uveal pigment near the root of iris, has disappeared over several small areas. *Vitreous* clear, but with slight loss of consistence.

Retina in situ; in y.s. region a group of small hæmorrhages, roughly circular in shape; and three similar extravasations on nasal side of disc. Veins very full. *O.D.* slightly cupped.

Choroid apparently healthy.

O. N. sheath is dilated immediately behind the eyeball.

Microscopic Examination after Hardening.—*Cornea*, thin but exhibits no structural change. *Iris*, greatly atrophied, especially in peripheral half. There is close adhesion of iris to

cornea at iris-angle, this adhesion being of noticeably greater extent at the temporal side, over the area on which the displaced lens presses. A migration of uveal pigment into the cornea has taken place at this part, and the pigment cells have collected around Schlemm's canal. This change has occurred only at lower and outer part. There is slight ectropium of uveal pigment at pupillary edge. The *ciliary muscle* is much degenerated, its bundles of fibres (especially the circular) being largely replaced by fibrous tissue. This degeneration is more evident on temporal side. The *ciliary processes* are considerably atrophied.

Lens hardened, measures 4·25 mm. and 7·75 mm., in its antero-posterior and transverse diameters respectively.

Retina. There is atrophy of nerve-fibre and ganglion-cell layers. The ganglion cells have in some places entirely disappeared. The hæmorrhages are nearly all confined to the three innermost layers of retina, but some have extended as deeply as the outer granule layer, but have not penetrated it.

The *optic papilla* is slightly excavated, the nerve fibres in front of the lamina cribrosa being so atrophied as to be scarcely recognisable, and the central retinal vessels are left exposed. The retinal vessels, where cut across in the sections, are all full of blood; their walls are little if at all thickened, but have a suspicious hyaline appearance, as if degenerate. No evidence of thrombosis obtained in the specimens. The portion of the O. N. removed with the eyeball (about 4 mm.) exhibits considerable change. The nerve-fibre bundles are atrophied, and there is a proportionate increase in the amount of fibrous tissue. The inner sheath is thickened, and the intersheath space, which is larger than normal, contains some apparently thickened loose fibres, and a number of small concentrically striated bodies, like the corpora amylacea often found in the meninges of the brain. There is no increase in the number of small vessels throughout the nerve; those present exhibit slight thickening of their walls, which have an hyaline appearance; but without any concentrically arranged fibrous tissue around them, such as Brailey and Edmunds* describe. These changes are most marked immediately outside the lamina cribrosa, but extend to the cut end of the nerve.

* Ophthalmic Hospital Reports, vol. x, Part I, p. 86.

Case II (*Reg. No.* 1765). — *Wound of Cornea; Dislocation of Lens; Hæmorrhage from Ciliary Body and Choroid; Commencing secondary Glaucoma.*

Male, æt. 66. Left eye struck by a 2″ nail nine days before his admission to hospital, on March 25th, 1885. When admitted, the notes are: Right eye, healthy; Left eye, V-shaped scar in cornea at upper outer margin. P. dilated, circular. Lens dislocated upwards and outwards. T + ?. V = fingers at 3″.

Severe pain came on and T. became +1. Eye excised April 9th.

Examination after Hardening.—*Cornea* curvative irregular; upper and outer parts thickened and slightly bulged forwards, at site of wound. *Iris*, very narrow, thick; adherent to peripheral part of cornea, blocking the iris-angle. *Lens* dislocated upwards and outwards behind the ciliary processes, against the inner surface of which it rests. Its lower and inner edge is slightly tilted forwards and is just below the centre of the pupil. There is a thin lamella of opacity in the lens, both the nuclear and cortical parts being clear. A delicate band comes forwards from vitreous below its edge, and is adherent to cornea at lower end of the scar. *Vitreous* clear, slightly shrunken and detached from retina posteriorly. The *retina* is in contact with choroid everywhere. No hæmorrhages in it. At equator, below, there is a shallow detachment of choroid and retina from sclerotic; the space is filled by blood clot.

Microscopic Examination.—Scar in *cornea*, at upper part, through its whole thickness; it is filled by new tissue with many nuclei.

The *iris* is contracted and narrow, but thick, and is adherent to the cornea at periphery, following closely the slight irregularities of its posterior surface. On the temporal side, where the lens has rested against its root, the iris is thin and atrophic; but towards pupillary border it becomes thick again, and is of greater thickness than the corresponding part on opposite side of pupil. This very marked contraction of the iris has given rise to abnormally deep grooves or folds on its anterior surface. There are very slight signs of inflammation in it.

The *ciliary muscle* and *processes* show no structural change,

except in one part, on which the lens rests; here hæmorrhage has occurred between ciliary muscle and sclerotic, separating them, and the blood has penetrated among the fibres of the muscle.

At lower part, the band stretching forwards from vitreous originates in that portion adjoining the ciliary processes, and passing close to lower border of the displaced lens, becomes adherent to the cornea at the lower end of the cicatrix. It is composed of homogeneous fibres, which stain badly, and closely resemble the fibres of the suspensory ligament of the lens. It appears to support the lower edge of the lens.

The *lens*, which is of normal shape and size, rests by about $\frac{1}{3}$ of its anterior surface against the ciliary body, the remainder of its anterior surface being free in the pupil. There is no discoverable wound of the capsule, nor any noticeable alteration in the lens-fibres.

The *vitreous* is shrunken, but shows no inflammatory signs.

The blood-vessels of the *retina* are all full. No pathological changes found in this coat or the *choroid* (except the hæmorrhage previously mentioned), but in several places the pigmented epithelium tears away with the retina from the choroid, looking as if there had been some slight inflammation. The *optic papilla* and *nerve* appear healthy.

Case III (*Reg. No.* 1806).—*Dislocation of a Cataractous Lens during Violent Coughing; no Symptoms during twelve years; then Attack of Pain and Increase of Tension.*

Male, æt. 67. Fifteen years before admission the sight of left eye failed gradually without any assignable cause. It remained "quite blind" for three years. Patient thinks there was "a cataract on the sight." Then after a violent fit of coughing he found he could see with that eye. He retained the full amount of sight thus recovered for nearly 12 years, and the eye never gave him any trouble. A fortnight before admission he "caught cold" in left eye; severe pain supervened and sight failed. On admission: R. $\frac{20}{20}$. L. counts fingers at 18″; cornea hazy, A. C. deep, iris tremulous; lens seen in lower part of vitreous; T +1 or 2.

After excision the eyeball was divided into anterior and posterior halves.

The *lens*, which is opaque and slightly shrunken, lies at lower part of eyeball, against inner surface of retina, a short distance posterior to ora serrata. There is no naked eye change in the *vitreous* over it; in the *choroid* there is a single patch of atrophy, with pigment accumulation at its margin, close to but slightly anterior to the position of the lens. The *retina* and *choroid* elsewhere both look quite normal.

The A. C. is filled by coagulated soft semi-transparent effusion. The *cornea* and *iris* exhibit no naked eye change; the *ciliary processes* are not evidently altered.

Microscopical Examination.—Cornea. No alteration in its substance; at limbus there are very numerous vessels, with some small cell accumulation beneath conjunctiva. The A. C. in the sections, contains some portions of the coagulum which filled it; these consist of a very fine fibre-network with some faintly granular material. Adhering to the post surface of the cornea are several groups of large rounded granular cells, each with a single, usually central, nucleus; similar cells are present on anterior surface of iris, in considerable numbers, and a few are seen on inner surface of ciliary processes and pars ciliaris retinæ. The angle of A. C. is large, and there is no sign of adhesion of iris to cornea. Among the trabeculæ of the ligamentum pectinatum, in the spaces of Fontana, are considerable numbers of small staining cells, which also extend to and surround Schlemm's canal. The corneal portion of the ligament is more than usually prominent, partly perhaps from traction by the iris, which is at a greater distance from it than in an eye with an A. C. of normal depth, and partly from the collection of cells in large numbers among its meshes.

The *ciliary muscle* has undergone very little change; a few of the bundles of circular fibres have degenerated and are replaced by a fibrous tissue. There are no inflammatory signs in it. The *ciliary processes* though perhaps slightly too prominent are not (microscopically) inflamed.

The *iris* appears healthy; there is no membrane in the pupil.

Close to the spot at which the lens lay, the *retina* and *choroid* are slightly adherent; and at the patch of atrophy

mentioned above, the *choroid* is reduced to a very thin layer, with much pigment heaped up around it. Elsewhere both these coats show no evidence of pathological change.

The *optic nerve* and *papilla* are healthy, and the central retinal vessels are free from inflammatory signs.

The physiological pit in O. D. is filled by a material consisting of numbers of small leucocyte-like cells, and a few larger granular cells, with some fibrillated structure; the whole mass probably being altered vitreous. Similar material is adherent to retina in neighbourhood of optic papilla. The bulk of vitreous was unfortunately lost, so that no microscopical examination of it was made—but the appearances at the disc render it probable that it had undergone some degeneration and cell infiltration.

Case IV (*Reg. No.* 2021).—*Perforating Wound at Sclero-corneal Junction; Entanglement of Iris; Wound and Dislocation of Lens; Severe Plastic Inflammation; Onset of Sympathetic Ophthalmitis seven weeks later.*

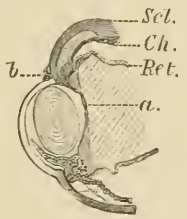
Female, æt. 43. Blow on right eye by handle of a mangle 13 weeks before she came to hospital. Sight lost "at once." The injured eye gave her very little pain, and she only applied for advice on account of failure of the left eye for the past six weeks. On admission: Right, shrunken and becoming squared; cornea steamy, shallow A. C. On inner side just beyond corneal border are two prolapsed portions of iris; iris wanting in inner half. Lens not quite clear. T. —. Left, sympathetic ophthalmitis. Right excised and opened by antero-posterior section.

Cornea irregularly thickened. At its nasal border is the scar of a wound, at the upper and lower ends of which there is a small prolapse of iris. This scar externally is just at sclero-corneal junction; its course is oblique, so that internally (on posterior surface of cornea) it is well in corneal tissue. The *iris* is entangled in whole length of the scar, but only shows externally at its extremities.

The *lens*, which is bulky, approximately spherical in shape, and partially opaque, is dislocated. It lies obliquely, its inner edge being displaced inwards and forwards, and is in close apposition with cornea, iris, and ciliary body. Between the

lens and cornea on temporal side, the iris intervenes. The ciliary processes are apparently swollen and the choroid thickened. On its inner surface, in temporal half of eyeball is a layer of grey jelly-like material, which separates the *retina* from the *choroid*. Elsewhere the two coats are in contact. The *papilla optica* is prominent; *vitreous* fluid in greater part.

Microscopic Examination. — In the neighbourhood of the wound (*b*) the *cornea* is infiltrated with small cells, and slightly increased in thickness. The wound is occupied by tissue containing large numbers of nuclei and some pigment, and evidently consists chiefly of iris, though it is unrecognisable as such. The *ciliary muscle* and *processes* adjoining the wound are much disorganised. The *iris* at temporal side is between the displaced lens and the cornea, with both of which it is in contact. It is inflamed, and the uveal layer considerably disturbed. On its posterior surface, between it and lens capsule, is a thin layer of new tissue; this passes over the root of iris and tips of ciliary processes and round the edge of lens, then extending across (*a*) close to posterior lens capsule, it becomes continuous with the scar tissue and the cornea on the nasal side. In this tissue, which consists of well-formed long fibre-cells, some new vessels are developing behind the lens. The



lens has been wounded on the inner side just behind its equator, and the fibres are, at this part, much degenerated. Similar changes are extending along cortical layers, chiefly beneath posterior capsule. The *choroid* is intensely inflamed, and thickened throughout. It is packed with small cells. Its inner surface is corrugated, and shows here and there small colloid outgrowths. The pigment epithelium remains adherent to choroid. The *retina* is inflamed, but far less severely than

the choroid. The *O.D.* is swollen, but there is very little hypernucleation either at the papilla or in the portion of nerve removed. In the intersheath space close to eyeball there is slight noticeable increase of tissue.

Case V (*Reg. No.* 2032). — *Wound of Conjunctiva and (non-perforating) of Sclerotic. Dislocation of Lens between Ciliary Body and Sclerotic.*

Female, æt. 38. *Right* eye struck by a clasp knife thrown at her 12 days previously.

When admitted to hospital the following notes were made. R. Blood in A.C. P. widely dilated. No reflex from fundus. V. = hand reflex. T.n. A fleshy granulation on conjunctiva at lower part. L. My. — 5 D., otherwise n. After removal of the R. eye there was found to be a moderate amount of hard irregular thickening on the external surface of the sclera at lower part of globe, surrounding the insertions of inferior rectus and inferior oblique muscles. On dividing the eyeball, the following conditions were observed:—*Cornea* unaltered. No scars of wound discoverable. Some blood clot in A.C. *Lens*, which is of normal shape and nearly clear, lies against sclera and sclero-corneal junction at lower part; the lower two-thirds of its anterior surface being in apposition with the sclerotic; the upper one-third projecting into A.C. (*see* Woodcut). It measures 4 mm. antero-posteriorly, and 8·5 mm. transversely. On its posterior surface the ciliary body and iris rest, the latter thickened, and contracted to a very narrow rim.

The *ciliary body* is torn from the sclerotic all round, but the separation is very slight except where the lens intervenes. The *retina* and *choroid* are in apposition throughout; but the latter is separated from the sclerotic at equator below, by some blood clot. The *vitreous* contains some blood, and about the lens and ciliary processes at lower part a small quantity of coagulated blood is lying.

Microscopic Examination.—The posterior half of eyeball was unfortunately lost. The *lens capsule* is apparently intact, and the lens fibres show very little change, but some degenerative process is beginning at the central part. The attachment of ciliary muscle and iris to sclerotic is completely broken through.

The ciliary muscle and iris are contracted and thick, and the latter contains some extravasated blood. A thin layer of blood covers the anterior surface of vitreous. The iris where not in contact with lens is rather less contracted and puckered. Its

origin has been ruptured in whole circumference. No inflammatory signs are present except in sclerotic and episcleral tissue at lower part. The sclerotic here contains numbers of small staining corpuscles, and on its outer surface is a moderately thick layer of tissue (*i*), consisting of an irregular fibrous network with numerous nuclei and connective tissue corpuscles; it is not very vascular. No trace of perforating wound discovered. In anterior part of sclerotic below, at a point corresponding to the granulation on conjunctiva is a small scar, well healed, and only extending half-way through the sclera.

The above cases, in which displacement of lens occurred, offer several points of interest and doubt. In Case 1 a not unusual form of dislocation of the lens gave rise, as it so frequently does, to a secondary glaucoma with macroscopic and microscopic changes, typical of increased tension, of some duration, whether primary or secondary. The blocking of the iris angle must have occurred first, at that part upon which the displaced lens exerted pressure. By interfering with free drainage over this area, more work would be thrown upon the excretory channels in the angle of the anterior chamber in the rest of its circumference; and although this angle (from the absence of the lens behind a large part of the

iris) must have been larger than normal, the task proved too severe, and the iris was forced forwards against the periphery of the cornea, to which it became adherent all round. A sufficient degree of tension to obliterate sight appears to have been established within a month of the accident. The hæmorrhages in the retina were recent; and there were no traces of former extravasations. In Case 2 a similar displacement had occurred, and like conditions were apparently being set up. The eye was excised 14 days after the injury, yet already adhesion of the iris to cornea at periphery was evident.

Case 3 is one of some rarity. The lens, which was probably cataractous and slightly shrunken, became dislocated into vitreous during violent coughing; and during a period of 12 years it gave rise to no symptoms. The pain and other symptoms which brought the patient to hospital were attributed to "cold," and though he stated that the sight of the eye had failed, there was no evidence that it had been previously any better than on admission, when it was about as good as might be expected in an aphakic eye. The cause of the increased tension is doubtful; there was no adhesion of iris and cornea to block the angle, but there was a noticeable cell aggregation in the meshes of the ligamentum pectinatum and about Schlemm's canal, which might not unreasonably be expected to, at least, retard the outflow in this situation.

In Case 4 the changes found after excision must be attributed less to the effect of a dislocated lens than to the perforating wound, and the probable introduction of a *materies morbi*. The inflammatory processes which ensued were of a plastic nature, and new tissue developed, forming a layer (shown in the Woodcut) which encircled the crystalline lens. In the posterior part of the capsule, behind the lens, new vessels were found in process of development; a condition, I believe, not very often met with.

Case 5 is an example of a rare form of displacement, and it is not easy to understand from a mechanical point of view how such a dislocation could occur. The fact that the anterior attachment of the ciliary muscle and iris were broken through in the whole circumference, favour the inference that the lens, which had been dislocated into the A.C., had simply slipped into the space between the choroid and sclerotic at the most dependent part; but I am disinclined to think so, as the lens was so firmly held in its new position, that it could not be shaken back into the anterior chamber immediately after removal of the eyeball. The eye was presumably myopic (the L. eye had My. of 5 D.), and the attachment of iris and ciliary muscle would be weaker and more easily ruptured than in an emmetropic or hypermetropic eye.

In Vol. I of the "Ophthalmological Society's Transactions," Mr. Nettleship has recorded a case, in which an opaque lens disappeared into a pouch, apparently between the choroid and sclerotic *at the upper part*, when the patient lay down, and slipped back into the A.C. on his resuming the erect position. There was a history of a blow some years previously. It is possible that in this instance a dislocation similar to that of Case 5 had occurred, and that as time went on, the lens became so much shrunken that it was able to escape from its nest between the sclerotic and ciliary body, and appeared in the anterior chamber. Such might have been the ultimate result in Case 5 had the eye not been removed.

NOTES ON IN-PATIENTS.

By E. Treacher Collins,

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I. *Four Cases of Interstitial Keratitis, with Ulceration of Cornea.*

The following are the notes of four cases of an unusual type of interstitial keratitis, all of which commenced with opacity of the cornea, followed by intense vascularity, beginning at the margin and gradually extending all over, until ultimately only a small central island of non-vascular structure was left. This central patch became yellow, and afterwards ulcerated; in one of the cases the ulcer perforated, in the others it cicatrised. The vascular part of the cornea gradually cleared up, but the central portion remained permanently opaque. In all four cases there were unmistakable signs of inherited syphilis, either in the teeth or in the physiognomy. Mr. Jonathan Hutchinson, in his book on "Syphilitic Diseases of the Eye and Ear," has recorded and pictured one somewhat similar case, in which he says, "there appeared to be a deposit of pus in the centre of the cornea between its layers. The whole surface of the cornea was of deep cherry-red colour, from the interlacing of minute vessels," and he goes on to say, "so acute an inflammation of the corneæ as occurred in this instance I have never before witnessed in connection with hereditary syphilis. The girl's feeble health and under-fed condition, taken together with the exhibition of mercury in such doses as to be a powerful depressant, ought probably to be made to explain this unusual severity."

In the following cases, however, all the patients were robust, and had not been subjected to large doses of mercury previous to the appearance of the acute symptoms.

Case 1.—Matilda W., a well-nourished, rosy-cheeked girl, with prominent frontal eminences, a depressed bridge to her nose, and scars about the angles of her mouth, but regular, well-formed teeth, æt. 10, came to the hospital first on New Year's Day, 1885, under Mr. Lawson. Both corneæ were hazy and infiltrated, and at the margins were very fine networks of blood-vessels, which gradually encroached on all sides towards the centre of the corneæ. On March 16, central ulceration of both corneæ was noted, the remainder being everywhere vascular At the beginning of April the ulcer in the right eye perforated, and on October 4, 1886, the right cornea was staphylomatous and opaque; the eye painful, T. + 2; no perception of light. It was excised on October 12.

In the left eye the peripheral part of the cornea had cleared, but there was still a central leucoma, the pupil was active, and she could count fingers at two feet.

Case 2.—Theresa K., æt. 6, came first as an out-patient to Mr. Lang, on January 27, 1886. There was no specific history from the father, but the child was born puny; had had snuffles and a sore bottom; the next child, older, also had had snuffles. On admission into the hospital, on March 4, 1886, there was a sloughing central ulcer in the middle of each cornea, and both corneæ were completely vascular, and the T.—. On March 18 the ulcers were healing, and the periphery of the corneæ had commenced to clear; the tension of the left was still minus; that of the right normal. On April 12 the periphery was clear in both, but dense central opacities, larger in the left, remained. T. normal in both.

Case 3.—Henry J., æt. 21, has a markedly concave physiognomy, and very typically notched teeth; his lower jaw is so bent and prominent, that with his mouth shut there is fully a space of half an inch between his upper and lower incisors. He came as an out-patient to Mr. Gunn first on May 19, 1886. His right eye had then been bad three weeks; there was considerable ciliary injection, and the cornea was uniformly semi-opaque, like ground glass. In the left eye, which had been bad only four days, there was a haze of the cornea, and a vascular patch at the lower part. He was treated as an out-patient, taking hydr. c.

cret. in pills, and having atropine ointment and warm boracic acid bathing locally. The vascularity of the cornea had increased considerably by June 12, when he was admitted into the hospital; he was then given hydr. c. cret. in pills twice a day, which soon began to salivate him, and ung. atropiæ sulphatis grs. iv to ʒi, to be put into his eyes three times a day. The atropine caused swelling and redness of the lids, and duboisine had to be substituted. The corneæ became uniformly vascular and ulcerated in the centres, but they healed without perforating, and the corneæ ultimately cleared up, leaving dense central opacities, which were still present on October 8, 1886.

Case 4.—Walter R., æt. 14, came into the hospital under the care of Mr. Tay, on August 18, 1886. His teeth were very irregular and small, but not notched; his physiognomy was suggestive of hereditary syphilis. Inflammation had commenced in the left eye seven weeks previously; the cornea was then hazy all over, with a ring of vascularity all round, most marked above, where it extended 3 mm. within the sclero-corneal junction. In the right eye there was a white patch on the anterior capsule of the lens, and one posterior synechia, but no history of inflammation in that eye could be obtained. On August 30, the cornea was vascular all over, except the central part, which was staphylomatous. On September 17 a central yellowish ulcer, with distinct loss of substance, was noted, and the periphery had begun to clear. When last seen in November, the ulcer had healed, leaving a dense central opacity, and the periphery of the cornea was quite clear.

II. *The Treatment of Granular Ophthalmia with Carbolic Acid.*

So intractable a disease as granular ophthalmia has necessarily from time to time had many and varied forms of treatment tried for its cure. Of the numerous caustic preparations that have been used, nitrate of silver and sulphate of copper continue most in favour. Of late I have in several cases applied pure carbolic acid just liquefied, and believe it to be quite as efficacious as these caustics; it has this advantage also, that its application is

a much less painful procedure, on account of the local anæsthetic action possessed by carbolic acid. Further, it does not stain the conjunctiva when used for a prolonged period, as is the case with nitrate of silver. I paint it on the inner surface of the everted eyelids with a camel's hair brush, at intervals of one or two days, applying it more particularly at the seat of the granulations. I then syringe any excess off with a stream of water, being careful not to let the undiluted solution go either on the cornea or skin. The surface of the conjunctiva is turned white, and in a minute or two rendered anæsthetic; a slight amount of inflammation is set up, and destruction of the epithelium follows. Absorption of the granulations is stimulated, and the trachoma-coccus (supposing such to exist) is doubtless killed by the carbolic acid.

III. *Statistics of Cases of Extraction of Cataract before and since the Introduction of Cocaine.*

So much has been said and written of late on the evil effects of cocaine, that I think it may be interesting to make a comparison between the cases of cataract extraction occurring in the hospital during the year 1883, before the introduction of cocaine, and those treated in 1885, when cocaine made up with a saturated solution of boracic acid was used in almost all cases. In making this comparison, I have counted the number of cases of panophthalmitis, the number of cases of loss of vitreous, and the number of cases of severe iritis, with the following results:—

In 1883 there were 225 cases of extraction of senile cataract; 14 suppurated, or 6·2 p. c.; 32 cases lost vitreous, or 14·2 p. c.; and 16 cases had severe iritis, or 7·1 p. c. In 1885 there were 264 cases; only 3 suppurated, or 1·13 p. c.; 22 cases lost vitreous, or 8·3 p. c.; and 9 cases had severe iritis, or 3·49 p. c.

Mr. Morton, in the Royal London Ophthalmic Hospital

Reports for 1879, Vol. IX, published the results of 146 cases of extraction of cataract occurring in 1875 and 1876; of these 8 suppurated, or 5·47 p. c.; 6 lost vitreous, or 4·1 p. c.; and 18 had severe iritis, or 12·3 p. c. These figures speak for themselves.

MISCELLANEOUS CASES AND OBSERVATIONS.

By W. J. Collins, M.D., M.S., B.Sc. (Lond.).
Clinical Assistant to the Hospital.

Paralysis of External Ocular Muscles in Child aged Seven. No other Paralysis. Slight Cerebral Symptoms. Coma. Death in Five Weeks from First Symptom.

Agnes K., æt. 7, daughter of a coachman, a delicate child, complained on April 22 of sudden diplopia, and her mother noticed she squinted. On April 30 she was brought to Moorfields; there was then well-marked paralysis of the left external rectus and superior oblique muscles, the secondary deviation exceeding the primary. There was no other paralysis. The sight of the left eye had got rapidly worse since the supervention of the diplopia, and was now reduced to bare p. l.; the media were clear; the optic disc exhibited a misty outline, and the veins were tortuous; there was well-marked shot-silk appearance of the retina, and nothing else abnormal. On being questioned the mother said she had noticed the child had been more drowsy than usual, and at times sick; she had also complained of pain in the left brow. Otherwise, though delicate, the child was apparently sound. The right eye V. $= \frac{6}{6}$, and J. 1. The mother was warned of the possibility of danger, and advised to send for a medical man should any head symptoms arise. The child attended weekly until May 21, with but slight, if any, change in the symptoms, beyond some increase of the neuro-retinitis; on that day she was comatose in the evening, and Mr. Strugnell, of Highgate, was called in. He has kindly informed me of the subsequent history. The temperature never exceeded 101°; there were no convulsions of any kind; the coma deepened; on tickling the soles of the feet the legs were drawn up after a marked interval. The symptoms, he thought, pointed more to tumour than to meningitis. The child died on May 27. No *post mortem* examination was made.

A closely similar case to this, in a child aged 5, which was under treatment at the same time, completely recovered. Small doses of hyd. c. cret. and of pot. iod. were prescribed.

The possible gravity of ophthalmoplegic symptoms occurring in a child would appear to be greater than in adults, in whom the prognosis is usually very favourable, most cases yielding to continued treatment with iodide of potassium.

Feigned Monocular Blindness in a Girl aged Nine.

L. E. W., æt. 9, from Henley, came to the hospital on August 9, complaining that the right eye was blind; this had "prevented her attending school more than three days in the last six months." Her manner was suspicious, and her physiognomy not reassuring. She answered hesitatingly, and was prone to tears when pressed to answer questions. The eye was fully examined under homatropine, and nothing abnormal was discovered; there was no strabismus. With a prism diplopia was readily conceded, and the red and green letters were fluently recognised through the red and green spectacles. Her mother repudiated the suggestion of deceit, and protested that if her left eye was covered she could not find her way by herself. This done, she did not fall over or encounter any obstacle, but waved her hand feelingly in front of her, and skulked along, all the while keeping a sharp look out with the "blind" eye on those watching her.

Cataract Twenty-four Years Maturing.

William W., æt. 85, brings out-patient letter, bearing Sir W. Bowman's name, and the date 24th July, 1862, on which it is noted, "L.E., cataract mature, fingers within 6 inches; R.E. words of No. 2, myopic"; on September 18, 1883, there is a note, "J. 1 at 4 inches; R.E. J. 10 at 6 inches."

On September 21, 1886, the cataracts in both eyes were partial and immature; the left has a very dense white nucleus and cortical striæ, occupying all except the uppermost part; likewise in the right the upper part is alone clear. Through these gaps the fundus of each eye could be seen, and a large staphyloma discovered round each O.D.

An Argument in favour of Meridional Accommodation.

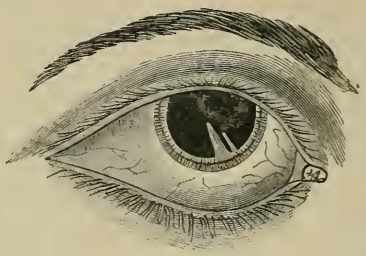
A girl, æt. 19, from Port Elizabeth, complained of myopia, for which she had been ordered -6 D. glasses for all purposes, but these did not relieve her asthenopia. By retinoscopy it was found that these spectacles overcorrected the myopia in all meridians, and -2 D. in the horizontal, and -5 D. in the vertical were the correcting lenses. On testing her with the types her vision was $\frac{6}{60}$ only with each eye, and with -2 D. barely $\frac{6}{18}$, but on adding -3 D. cylinders with the axes horizontal, it was improved to $\frac{6}{9}$. After being in the dark room a short while, on returning to the types she could read $\frac{6}{9}$ with a -2 D. spherical, without any cylinder, but with obvious and much complained of effort; suddenly the visual acuity dropped to $\frac{6}{24}$, but was at once restored by adding the cylinders formerly tried, and this was maintained without the slightest effort. These observations were repeated with other test-types, to eliminate the possibility of error, and the patient, who was very intelligent about her symptoms, was keenly sensitive to the advantage of the correction of the astigmatism, and of the increased effort to rectify vision in the absence of the cylindrical glasses.

This case is important and instructive, and the lesson it teaches needs to be borne in mind in the estimation and correction of astigmatism. It would seem that inequality of meridional refraction, which is corneal and static, is capable of more or less perfect correction by meridional accommodation, which is, of course, lenticular and dynamic.

Persistent Capsulo-pupillary Membrane.

Francisca S., æt. 21, complained of asthenopia, and on superficial examination the right eye presented an adhesion between the lens-capsule and the iris. On closer observation it was found that starting from a point just below the centre of the lens capsule, and passing downwards and slightly inwards,

behind the inferior internal quadrant of the cornea was a delicate fan-shaped filamentous structure, connecting the lens capsule with the circulus minor of the iris, on the anterior aspect of the latter. The iris was blue, and the radial fibrils of this membrane presented a lighter tint of the same hue. Vision with the right eye $= \frac{6}{9}$ c + 1 D. $= \frac{6}{9}$. The other eye is normal, and V. $= \frac{6}{6}$. The patient is certain she never had any signs of inflammation in the eye, and that the condition described has obtained all her life.



There can, I think, be no doubt that this is an example of the fœtal membrana capsulo-pupillaris persisting in the adult. This membrane is, of course, to be distinguished from the membrana pupillaris, the vestigial filaments of which pass diametrically across the circulus minor of the iris. This distinction is not insisted upon in most English works, but is well brought out in Müller's Physiology (Vol. II, p. 1632), based upon the descriptions of Henle, Krause, and other observers. In this case the capsular origin of the filaments was, as stated, from the neighbourhood of the anterior pole, but it would appear that the fœtal membrana capsulo-pupillaris is equatorially attached at its origin and to the pupillary margin at its insertion. This may be explained by partial adhesion of the membrane longitudinally to the capsule of the lens prior to its reflection forwards, and indeed one delicate thread, separate from the rest, did proceed from a point nearly midway between the pole and the equator of the lens. The adhe-

sion to the circulus minor of the iris, and not to its margin, is explicable on the ground of fusion with the posterior lamella of membrana pupillaris, which fusion is, according to Müller, by no means unusual, and often inseparable.

Failure of the Accommodation dependent on Prolonged Lactation.

I have recently published in the Lancet (November 6, 1886), a series of cases of cycloplegia or cycloparesis arising during the puerperal state, or during lactation. Within the last twelve months I have taken notes of ten such cases among out-patients of Mr. Lawson's. The last case which presented herself was highly typical of the class, and was not included in my former paper.

Sarah N., æt. 40. Has had eleven children; the last is eighteen months old. She is still nursing this one, and she nursed all the others for an equally long period. Her eyes have been failing of late, and during the last five weeks she has been quite unable to read small print, or do fine work. V. $= \frac{6}{12}$ each eye, and is not improved by any glasses. She cannot neutralise even $-$ 2 D., only reading $\frac{6}{24}$ through them. She can make out only J. 4, when held at 22 cm. and not J. 1 at any distance. With $+2$ D. she reads J. 1 at 22 cm., and ten minutes after the instillation of eserine she can do the same without assistance. The pupils are equal and active, about 3 or 4 mm. in diameter. There is no change in the fundus, and no appreciable amount of hypermetropia could be found with the ophthalmoscope.

The treatment of these cases is simple, and always successful. Weaning the child, good diet, and a tonic being, in the absence of hypermetropia, all-sufficient. Weak eserine drops are sometimes useful.

The cycloplegia of lactation is most common in young multiparæ, in hypermetropes, in those naturally delicate or otherwise debilitated. It is seldom complete, the iris is rarely affected, the visual acuity is a little subnormal, and the fundus beyond being anæmic, is healthy.

NOTE ON CERTAIN RETINAL REFLEXES VISIBLE WITH THE OPHTHALMOSCOPE.

By R. Marcus Gunn, M.B., F.R.C.S.,
Assistant Surgeon to the Hospital.

Ophthalmoscopic observers have long been familiar with the peculiar shifting reflex often met with in examining the eyes of young people, known as the "shot silk," or "watered silk" retina. Minor degrees of this condition are very common, but occasionally we find the shimmer particularly brilliant, playing over the inner surface of the retina with every movement of the mirror or of the patient's eye, now on one side of the larger vessels, now on the other, and often partially or even completely obscuring the vessel itself for a short distance. The extent of the brightly reflecting area associated with any one blood-vessel will be found to vary much in different parts of the vessel's course, apart altogether from movements of the mirror or of the patient's eye. The inner edge of the bright band is usually very near but not quite continuous with the vessel, while the band itself is sometimes quite narrow, sometimes extends for a considerable distance, and ultimately perhaps joins a similar reflex in association with a neighbouring vessel. On tilting the mirror the reflex may be made to flash across from one to the other side of the vessel, where similar variations in the breadth of the illuminated band may be observed. If a vertical vessel be regarded by the direct method the reflex will be seen on the same side of the vessel as that from which it is illuminated.

A somewhat similar retinal reflex, but always narrow in this situation, may be observed to map out the region of the macula, describing an elongated oval with its long axis horizontal.

These reflexes are best seen in a dark fundus, using a

highly concave mirror by the direct method. I do not recollect ever to have seen them well marked except in cases of hypermetropia; certainly never in high myopia. Schirmer* was, I believe, the first to describe these appearances, but he offers no explanation. Parent† attributes the general retinal shimmer to the reflecting property possessed by the *limitans interna* in young people; with age, he says, its structure changes so as to render it less able to reflect light. The macular ring he considers due to the thinning of the limitans and the scarcity of Müllerian fibres in this locality.

My present object is to draw attention to known anatomical facts which may, I think, assist in explaining these phenomena.

The limitans interna does not by any means present a uniform concave surface, but has often slight, and sometimes considerable irregularities in its curvature. The larger retinal vessels often lie superficially in the nerve-fibre layer, and the limitans interna, instead of stretching straight across, is here elevated by the convexity of the vessel, so that on section we get an appearance such as is diagrammatically represented in Fig. 1.

FIG. 1 shows diagrammatically the relation of the limitans interna to a large retinal vessel.

We thus have a projection of the limitans corresponding to the course of the vessel, with a concavity on each side of it. The vessel does not, however, maintain the same uniform level in the retina, but undulates anteroposteriorly, as is often well demonstrated in cases of

* Dr. Rudolf Schirmer. Ueber das Ophthalmoskopische Bild der Macula lutea. Graefe's Archiv f. Ophth., Bd. X, Abth. 1, p. 148 (1864).

† Parent. Étude sur les reflets de la rétine. Recueil d'Ophth., 1880, p. 455.

papillo-retinitis, where the vessel is occluded by the altered nerve-fibre layer when deeply placed, coming again distinctly into view when superficial. Again, in the yellow spot region outside the fovea centralis, the retina is thicker than it is in the perimacular region, so that we have a convexity near the periphery of the macula, with a concavity bounding it externally.

Fig. 2. Diagrammatic section through the fovea centralis and macula.

I would suggest, then, that the light from the mirror falling upon the sloping side of such a convex surface, and meeting it at its "critical angle," undergoes total reflection, and thus illuminates an area of the neighbouring retinal surface. This reflected light is visible to the observer, when it ultimately falls upon a surface so placed that reflection takes place in the direction of and through the pupil of the eye under examination. The changes in the curve of the hyaloid due to the dipping of the vessel previously mentioned would account for the shimmer being occasionally visible over part of the vessel's course.

But, it may be asked, why is the reflex not universal, and when present in youth why does it not persist in later life? It may be that the limitans interna varies in reflecting power in different individuals, or in the same individual at different periods of life as Parent suggests, but in the absence of any direct proof of this variability, another explanation may be hazarded. That the appearance is not universal even in the young is probably due to the fact that all such retinæ do not present irregularities of their inner surface sufficient to allow of the reflected rays again becoming visible. The retina, developed from the epiblastic optic vesicle, may often be too large to conform regularly with the inner surface of the mesoblastically formed outer coats, so that unusually great irregularities

will consequently exist on its inner surface.* As the eye grows, however, the incompatibility will gradually become less, and by the time adult age is reached, the retina will be more accurately fitted to its enclosing cup, and the pre-existing irregularities to a large extent flattened down.

The deep concavity at the fovea centralis may similarly account for the bright reflex often obtained there.

I may here observe that during the past year I have in several instances seen a very peculiar foveal reflex in association with myopia. It presents the appearance of a small, fan-shaped, illuminated area, with its apex at the fovea, extending away from it at the side opposite to that from which it is illuminated, so that by minute mirror movements it may be projected on every side of the fovea in turn. The following case is cited in illustration :—

Lilly B., æt. 7. Seen Feb. 2, 1886.

Right. V. $= \frac{2}{24}$ partly; $\bar{c} - 2$ D. $= \frac{6}{24}$.

Left. V. $= \frac{2}{18}$ partly; $\bar{c} - 2$ D. $= \frac{6}{18}$.

No higher spherical or any cylindrical glass further improves vision.

Ophth.—Myopia nearly 3 D. Media clear. Fundus normal, except that at the fovea centralis there is a peculiar fan-shaped reflex in front of the retina, reminding one of the appearance produced by a bull's eye lantern shining out into a fog.

In all the cases observed the vision remained defective on full correction of the ametropia. The myopia

* For this suggestion I am indebted to Mr. Nettleship, who has referred me to Ammon's account of the folded condition present in the fœtal human retina. The occasional persistence during early life of minor degrees of this folding seems quite plausible in the case of hypermetropic eyes. See Ammon ; Die Entwicklungsgeschichte des Menschlichen Auges, Berlin, 1858, pp. 97 and 212, and Taf. vii, figs. 5, 6. Ammon also describes the inner aspect of the retina when in this condition as having a mother-of-pearl lustre. He found the folds present from the fourth to the eighth or even ninth month of fœtal life.

varied between 3 D. and 17 D. in different cases, but in the higher degrees other myopic changes existed to account for the amblyopia. The ages of the patients observed ranged from 3 to 17 years. The appearance is possibly accounted for by some unusual disposition of the fovea, either in its shape or degree of excavation; or by a localised detachment of the hyaloid membrane with the intervention of a turbid fluid between it and the retina.

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Part I.

Original Contributions.

ON SOME OF THE FORMS OF CONGENITAL AND INFANTILE AMBLYOPIA.

By E. Nettleship.

(The substance of three Clinical Lectures given at the Hospital on May 18th and 25th, and June 1st, 1887.)

Lecture I.

Gentlemen,

I propose to notice in this lecture several forms of congenital defect of sight due to changes which we can see at the fundus or can infer to be due to disease of the optic path.

The first case I will allude to is that of a baby (Chas. Francis, æt. four months) who was brought by its mother a week ago, because for the last few weeks it had not taken notice as it had done before. There was nystagmus, but the child usually looked towards the window and was, therefore, not quite blind. The pupils were active to light. The vitreous in each eye was so full of fine opacities that the fundus could not be defined.

The appearances in this case being just such as would in an adult lead to the strongest suspicion of hyalitis from inflammation of choroid or retina in the later period of secondary syphilis, we made similar enquiry in the baby's

case, and found a clear history of congenital syphilis. Though inflammation of vitreous consecutive to retinitis or choroiditis is seen every day in acquired syphilis, usually within 12 to 24 months of the infection, we do not see it nearly so often in the corresponding stage of the hereditary disease; not, I think, because it is relatively less common, but because the children are often not brought till the mischief has run on into the stage of choroidal and retinal atrophy, a stage at which the vitreous has nearly cleared. I have notes of another case exactly like the above, in a male baby of five months suffering from snuffles and rash, but as the child was only seen once the particulars are less interesting (John Dris-lane, St. Thomas's, O. P., April 18th, 1881). More commonly we see them in the state described in—

Case II.—Mary E. Hall, æt. 2½ years (M.O. 2, 56); here considerable improvement occurred in V. during the four months she was under notice, and taking mercury. On admission she saw very badly, the field being apparently small; vision had been, as was thought, getting worse for a few weeks; disseminated choroiditis was found in R., and diffuse retinitis in L., no choroiditis being made out there. The patient was the eighth born; the first six children died young, and the father admitted having had some venereal disease before marriage.

The prognosis in choroiditis occurring in the secondary stage of hereditary syphilis is pretty good if treatment be begun tolerably early. Thus,

Case III.—John Eaton was brought, though not early enough, when about a year old with diffuse retinitis and white spots of choroidal disease in the L., and opacities in the vitreous in the R. His sight was then very bad, but improved greatly under mercurial treatment which was kept up for a very long time. When old enough to go to school (about æt. five years) his R. was found to be nearly blind (it had no doubt been so all along), with the L. he saw well $\left(\text{V. } \frac{20}{50} \text{ and 1 J.}\right)$ in the day, but badly at night. The R. o.d. was now hazy and atrophied, with

extremely diminished retinal vessels and choroidal disease. The conditions in L., though of the same kind, were much less in degree, and were probably stationary. At the age of seven he had a typical attack of keratitis in the R. (or blind) eye which ran an ordinary course.

Choroidal disease is not always easily made out in babies on account of the absence of pigmentation about the patches, and the naturally pale colour of the choroid at this time of life. When, as seems common, choroiditis occurs later in hereditary syphilis, during or after the keratitis period, when the hair and skin and with them the choroid, have usually darkened, there is often extreme pigmentation of the patches, even more than in choroiditis in adults.

Before giving instances of other forms of infantile blindness, let me say a few words on the general diagnosis of defective sight in infants. It will be self-evident that no exact tests of vision can be applied, and that an infant's sight may easily seem worse than it is. The chief things to notice are whether the child turns its eyes towards the window, or follows the flash of the mirror in the dark room (or what comes to the same thing, turns its head away or blinks its lids under the same tests), the presence or absence of nystagmus and the state of the pupils. No doubt all babies do not learn to notice, *i.e.*, follow and look at objects, at the same age—I believe that they usually look at a bright light thrown steadily into the eyes a day or so after birth, but that from three to six weeks' education is necessary to enable them to follow a moving object in such a way as to give the appearance of intelligence or "noticing"—and it is failure to "notice" that raises the mother's apprehension, especially if she has had other children whose behaviour was different. If the infant's eyes oscillate rhythmically, or even wander constantly though irregularly, its sight is almost certainly bad, for we know very little of primary nystagmus from nervous disease in infants. The pupils are less useful in

babies than in adults, because the movements of the infant's eyes at once embarrass observation, and lead to associated movements of the pupils independently of alterations in light, and because the natural range of pupillary action in infants seems to be less than it is when the eye has attained full development. Though I need hardly add that in infants as in adults serious loss of acuteness of vision is compatible with fairly active pupils, I think it is less generally known that, in children at any rate, the light reflex may be present even though the child be absolutely unconscious of light, a condition of which I shall be able to give several instances further on. In examining the pupils of a baby, avoid touching the face or head, and so provoking movements of his head or eyelids.

I propose to illustrate in the present lecture three other groups of infantile amblyopia, besides the examples (forming *Group* 1) of syphilitic choroido-retinitis and hyalitis already narrated:—*Group* 2. Microcephalous infants with gross choroiditis, apparently not syphilitic; *Group* 3. Failure of sight without papillitis coming on during an illness diagnosed as meningitis but not ending fatally; *Group* 4. Blindness in infants, without history of acute cerebral symptoms, and frequently, as in *Group* 3, without ophthalmoscopical change.

In every case of infantile blindness it is important to observe the shape and size of the cranium (as compared with the face), and the condition of the fontanelles and sutures; to enquire fully into the question of congenital syphilis, and of any acute illnesses the child may have had; of defective sight or intellect, or other cerebral or spinal disease in any kinsfolk; and of consanguinity of parents; and it must be remembered that a baby may of course be very well nourished although syphilitic.

Group 2.—This group contains certain rare cases of infantile blindness from gross disease of the choroid, with smallness of cranium, premature closure of fontanelles and

ridging of sutures, but without evidence or history of hereditary syphilis, or other assignable cause. Possibly the disease occurs before birth. In the first case of this sort that I saw (published when incomplete in Vol. VIII of these Reports, p. 518), the head was considerably too small, and the sutures closed for some time; the head afterwards slowly enlarged (after the case had been published) into a condition of well-marked chronic hydrocephalus. I have seen only three other cases which bear comparison with the above, and as the conditions are evidently rare I give the particulars.

Case IV.—Theodore Lee, æt. 1 year (12/7/80, St. Thos. Hosp.). The youngest of four children (three living); first had a large head and died of convulsions. Patient is weak in back, and has no use in legs. No rickets. Small cranium. Premature closure and ridging of sutures. Thought not to take notice. No doubt idiotic. Ps. about $3\frac{1}{2}$ mm. in light, dilate moderately when covered, and contract pretty briskly. *Ophth.:* R. o.d. pale on y.s. side, with a crescent; large area of capillary atrophy of choroid at y.s., with a single patch of complete atrophy at its upper and lower edge; large vessels beautifully shown. L. o.d. normal, but a crescent; large round area of complete atrophy of choroid with clear white surface, and some pigment at edges; large tortuous vessels (? arteries) coming out of sclerotic near centre.

Case V.—Cath. Holt, æt. 10 months (St. Thos. Hosp., 30/7/83). No history of syphilis or phthisis. Is the youngest of three children. Two died when three years old; one of consumption, the other apparently from tubercular meningitis. Patient has never taken notice. Was well till five months old, then began to refuse breast and became weak and has not grown much since. Premature closure of sutures. Ps. act well. *Opth.:* R. o.d. very hazy; vessels normal; large patches of old choroiditis, chiefly of inner layers; stroma not often destroyed; no membrane or tissue on choroidal patches. L. same, but o.d. about normal.

Case VI.—E. Rochester (? sex) æt. nine months (St. Thos. Hosp., 7/10/79). Numerous fits since æt. two months; prema-

ture closure of sutures. R. eye of normal size; pupil atropised; ophth.: media normal; numerous patches of pink-coloured choroiditis, as if epithelium were removed, and deeper parts normal or congested and infiltrated; the patches are subangular or maplike, free from pigmentation, and not very large (none so large as o.d.); o.d. normal; doubtful p.l. L. eyeball too small; coloboma of iris not quite complete downwards; ophth.: immense patches of atrophied choroid with much pigmentation; no coloboma of choroid made out. In this case we have perhaps in L. intra-uterine choroiditis with arrest of development and subsequent (post-natal) choroiditis of the R.

We have now to consider the cases, and they are comparatively common, of blindness from birth, or from early infancy, with only slight ophthalmoscopical changes, or perhaps without any change at all. Of these we may place together (as *Group* 3) all such as give a history of meningitis (fits, unconsciousness or lethargy, vomiting, loss of power in limbs and back, retraction of head) at a very early age. I have not quite lately seen any well-marked case of this sort, and will therefore quote, shortly, the following examples from a former paper.*

Case VII.—Ada Knight, æt. 12 months (Case IX in the paper referred to). Was well till nine months old; then became insensible for a week, and during the illness became blind. At the Hospital for Sick Children "basic meningitis" was diagnosed. When I first saw her the head was enlarged, fontanelles widely open, and she had been blind two months. Ophth.: R. o.d. slightly pale, but quite clear. L. o.d. normal. Refraction H. in each. October 13th. Has been able to see for a month past, but not so well with R. as L. Evidently sees an object held straight in front of her. Can now sit up better, but not stand. February 7, 1882. Sees threepenny bit; uses her hands, but cannot stand. Ps. n. R. deviates out and up sometimes. October 31st. Can see to pick up a pin; cannot walk or get up if lying down, but talks well.

* "On Recovery from Amaurosis in Young Children," Trans. Oph. Soc., vol. iv, p. 243, 1884.

Case VIII.—(Case V, *loc. cit.;* Geo. H.). Meningitis, thought to be tubercular, at æt. 15 months. On recovering consciousness was blind. Two months later I found that he took no notice of ordinary things, but looked at bright light; ps. large (about 5 mm.), but contracted a little to light; fundus perfectly healthy in each eye. October 30th. Seems to see quite well; pupils act well, but are rather large; disc well seen in one eye, and quite healthy.

Case IX.—(Case XII, *loc. cit.*). Fits almost from birth. When 11 weeks old had slight retraction of head (Dr. Lees), but no paralysis or strabismus; æt. five months, mother says the child has been nearly blind for a month; takes no notice in daylight, but in the dark room follows light of mirror accurately with L., though less so with R. Ps. n. Ophth.: Fundus normal in both; discs perhaps slightly grey. Death soon afterwards; no post-mortem.

The above cases are examples of a very important series of which our knowledge is as yet only fragmentary, in many of which sight lost, by a meningeal illness, for a time, recovers more or less perfectly, without the occurrence either of papillitis during the illness,* or of marked atrophic changes afterwards. I believe it is not known in what way the sight is damaged without papillitis occurring. Fluid pressure in the ventricles does not offer a probable explanation, since there is no proof of any great increase of cerebral fluid; and even if there were such pressure, it would not account for the sight being worse in one eye than the other (as in Case VII and others); whilst, on the other hand, in ordinary chronic hydrocephalus, where the chiasma must be considerably pressed upon by fluid in the distended third ventricle, blindness (with optic atrophy), though well known, is, so

* The statement as to the absence of papillitis refers more particularly to the disease known as "posterior basic meningitis," and is made on the authority of Dr. David Lees, Dr. Barlow, and Dr. Abercrombie, who have had many opportunities of watching such cases in the early stages of the illness.

far as I have seen, not common in ophthalmic surgeons' practice. Whatever the mechanism may be, we may note as interesting the order in which the baby regains its functions; the sight returns before the power of sitting up or of using the hands, and the power of walking returns last.

You will, I am sure, not think that in drawing particular attention to blindness from infantile meningitis without ophthalmoscopical changes, I am overlooking the usual occurrence of papillitis in acute general basic meningitis, whether tubercular or not. When recovery ensues in such a case the patient is likely to be left permanently blind from post-papillitic atrophy.

Group 4.—In a certain number of infants, the blindness is not due either to syphilitic or other choroiditis, or to disease of the optic nerves from evident meningitis. In looking through the notes of these residual cases, some 22 in number, I have been struck by finding that considerably more than half of the patients (16 out of 22) are idiotic, or defective in intellect. Several of these had blind or idiotic relatives, but in only two was any consanguinity of parents known; in regard however to all such matters of family history the facts we are able to ascertain of course often represent less than the truth.

I do not wish you to suppose that this group is a homogeneous one, nor that all the many instances of blindness with idiocy which it contains are pathologically, or even clinically, similar. Some are congenitally microcephalic, idiotic, and blind, whilst in a few both brain power and sight were lost by disease coming on after birth. Some whose intelligence was good had probably suffered from unrecognised meningitis; but the group contains no well-marked meningitic cases, and scarcely any in which vision was recovered. I think we may draw the conclusion, in contrast with Group 3, that in cases of infantile blindness, with little or no ophthalmoscopical change, the absence of a meningitic history is usually

unfavourable to recovery of sight, and we shall find that in most of these the blindness dates actually from birth.

It is of much interest to notice that in some children blind from birth the pupils may act to light and shade, though the patient is, so far as we can ascertain, quite unconscious of the changing illumination. Thus in—

Case X.—An idiotic girl, æt. two years, who could neither walk nor speak, who took no notice of light or shade, and did not follow the mirror in the dark room, the pupils acted well to light (*loc. cit.*, Case XIX). The child, it is true, did sometimes turn her head away, as if annoyed, just when the light was flashed into her eyes; but this, though it may have meant perception of light, possibly only showed sensation of heat.

Case XI was that of another absolutely blind idiot æt. $2\frac{1}{2}$ years, in whom Dr. Walter Edmunds* found external hydrocephalus after death. During life I had noted that the pupils acted well to light. At the post-mortem the cerebral hemispheres and optic thalami were found to be very small and ill-developed, but the cerebellum, corpora striata, and in particular the corpora quadrigemina were plump and of healthy appearance.

The reflex mechanism of the pupil seems in this case to have been good, though the development of the visual (perceptive) centre had, in common with that of all the higher centres, been arrested. In the following more surprising case, we should have to suppose congenital absence of the visual centres alone, all other parts of the brain being good:—

Case XII.—This patient was a boy of 17 (*loc. cit.*, Case XVII) of good intelligence, and having all his senses well developed, except sight, of which he had never had a vestige since birth. So far as we could judge he had not the least perception of light, yet the pupils acted pretty well to strong contrasts of light and shade.

The optic discs in each of these three cases were of

* Trans. Path. Soc., xxxii, p. 4, 1881.

practically healthy aspect, and they therefore seem to give some support to the doctrine that the optic nerve contains reflex (pupillary) as well as visual fibres.

We meet with other patients who, having been blind or amblyopic all their life-time, do not come under notice till they are several years of age. Some of these no doubt would have fallen into the groups we have described had they been seen in infancy. We will consider them in the next lecture.

Lecture II.

We have now to examine certain cases in older patients who, though not blind, and having no cataract or other conspicuous disease, get on badly, and are often supposed, sometimes as we shall see with good reason, to need glasses. Sometimes, indeed, ametropia is the only assignable cause of the defect, as the following cases show. We will place them in *Group* 5.

Case XIII.—Maria M., æt. 24, has manifest and total H. amounting to 12 D. and little or no As; but V., when corrected, is only just $\frac{6}{36}$, and she can only read 4 J. held close to her. She has used +12 D. since she was 15, but whether she had worn any glasses before that age is uncertain. No nystagmus. The discs are red, but not hazy. Her eyes are prominent as in myopia, the orbits being I suppose shallow. Her father and all six of her brothers and sisters wear "very strong" glasses; one sister whom we saw was using +9 D.

I believe that acuteness is, as a rule, defective in very high degrees of hypermetropia; I have no notes of any where it was otherwise. Whether it is invariably so, and if so, what is the relation between the degree of amblyopia and of H., I have no means of deciding; I am not acquainted with any statement on the subject more detailed than that very hypermetropic eyes often see badly

because they are imperfectly developed. The question is one that might repay the trouble of observation; the enquiry should include the examination of the less specialised functions of light and colour perception, as well as that of visual acuteness, and it ought to be extended for all these functions to cases of anisometropia, in which, as we shall see in future, the acuity of the more ametropic eye sometimes is, and sometimes is not, equal to that of the other.

In the next case the H., which was the only unnatural condition found, was not even high in degree, and yet there was considerable defect.

Case XIV.—Jas. Chipperfield, æt. 6, in March, 1882, had rapid constant nystagmus and bad sight; his mother had got him some +3 D. glasses, with which he read 1 J. held close. Both before and after atropine he chose +2 D. for distance, V. being, however, only $\frac{6}{18}$; this result was verified by ophthalmoscopic measurement and by the shadow test. He matched the coloured wools quite well. No disease of the fundus. Glasses were changed from +3 D. to +2 D. Six months later with his +2 D. he still saw only $\frac{6}{18}$, and read only about 6 J., but there was now no nystagmus. It would be fair to suggest that this little boy's sight only seemed bad owing to his being shy or backward; but in favour of its being really defective we have the nystagmus, the want of improvement after six months' use of proper glasses, and the fact that his mother was so convinced of his difficulty that she had got him some strong glasses before coming.

In such cases as the two last the refractive error had certainly, and the amblyopia presumably, been present at birth; and we could not say of them, as we might possibly say of the following cases, that the amblyopia was a consequence of changes connected with the progressive increase of myopia.

Case XV.—"Sister" Mary E. (P. 13, 57), æt. 60, has myopia with As. in each, but V. only $\frac{6}{60}$ (or sometimes part of $\frac{6}{36}$), when corrected as follows:—

R. $\left\{ \begin{array}{l} -3 \text{ D.S.} \\ -2 \text{ or } 3 \text{ D.Cy. } 20° \end{array} \right.$ L. $\left\{ \begin{array}{l} -3 \text{ D.S.} \\ -2 \text{ or } 3 \text{ D.Cy. } 20° \end{array} \right.$

Constant, free, lateral nystagmus. Media and fundus (so far as can be ascertained), normal in each. Colour vision normal. "Nothing except the astigmatism to account for the defect." Had fits in infancy, and her sight has never been good; the eyes have always "worked." Two brothers have some defect of vision, but not nearly so great as hers. Clearly her visual defect cannot have been caused by the M. As., though the M. may have been indirectly brought on by the defect.

Case XVI.—Ada Ford, æt. 10, has well marked lateral nystagmus of both. V. (under atropine) R. $= \frac{6}{24}$, improved to $\frac{6}{18}$ with $\left\{ \begin{array}{l} -0{\cdot}5 \text{ D.S.} \\ -2{\cdot} \text{ D.Cy.} \end{array} \right.$ L. $= \frac{6}{36}$, improved to $\frac{6}{18}$ by $\left\{ \begin{array}{l} -1 \text{ D.S.} \\ -1{\cdot}5 \text{ D.Cy.} \end{array} \right.$ In each eye there is a crescent downwards, no other changes. Colour vision good (to wools). A history of ophthalmia neonatorum treated by "caustic for six weeks."*

The amblyopia in the last case is by no means very high, and possibly may be fairly attributed to the refraction and age of the patient; or to nystagmus acquired during ophthalmia neonatorum, and not since got rid of. But these objections are not applicable to Case XV.

It is, perhaps, a question in the above cases and others like them, whether a congenital (or infantile) amblyopia have caused the nystagmus, as we know very well that it may do; or the nystagmus, being present at or soon after

* May nystagmus in patients giving a history of ophthalmia neonatorum, but who do not now present any opacity of cornea or lens, be sometimes due to astigmatism caused by the ophthalmia reacting on the growth or form of the cornea?

birth, have caused the amblyopia, or perpetuated and heightened an amblyopia already present? On the one hand we may suppose that if central vision be defective at birth, so that the infant has less than the natural inducement to learn accurate fixation, the development of the cerebral mechanism for the co-ordinated movements of the eyes, will or may be arrested, and uncontrollable movements of the eyes (the rhythmical character of which need, I think, not surprise us) result. On the other hand, if we can suppose a child born with perfect eyes but with rapid nystagmus, there seems no difficulty in supposing that its full acuteness of vision may never be developed, and for two reasons: the best part of the retina, the *fovea centralis*, is not, as it should be, used continuously for fixation; whilst the impressions on successive parts of the retina are too brief to be well separated, and the effect will be more or less continuous vision, varying in clearness according to the part of the retina on which the successive images fall.* We must here ask *whether nystagmus* (without evident disease of the eyes) *is ever present really at birth?* However this may be, it must certainly be allowed that nystagmus is not acquired with equal facility by all persons. A few persons can make their eyes oscillate at will. An amount and kind of defective sight that will be followed by oscillation in one person, will not have that result in another. Defect or blindness of one eye alone occasionally, though not commonly, results in oscillation limited to that eye. The conditions which cause coal miner's nystagmus do not cause it in all of those who are exposed.† If a slight or even temporary

* This of course presupposes that the movements are quicker than is consistent with separate consciousness of successive impressions. Foster (Physiology) states that retinal impressions must be separated by intervals of something more than $\frac{1}{10}$ to $\frac{1}{30}$ of a second in order to be distinguished. That nystagmus may be so rapid as to be incompatible with this minimum exposure of each retinal unit, seems proved by the common experience that the disc is often invisible as such, in rapid nystagmus.

† Nieden (Trans. Internat. Med. Congress, 1881, London) points out

defect of sight can excite nystagmus in a baby predisposed to it, and the amblyopia be rendered permanent and possibly increased by the oscillation, we may perhaps, by this conjunction, explain such otherwise embarrassing cases as those above considered.

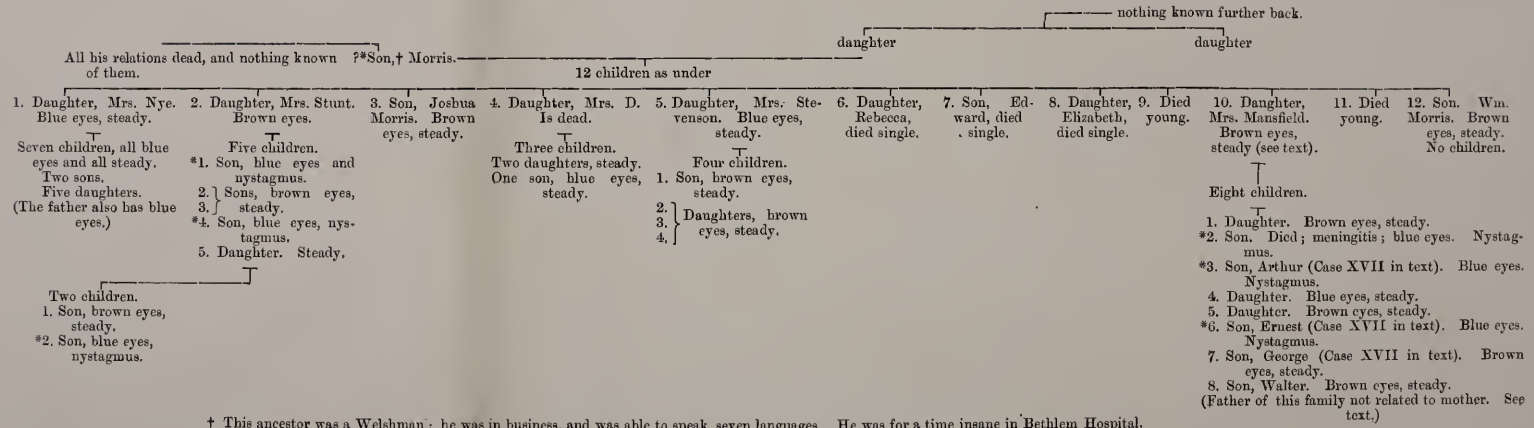
Case XVII.—In this very remarkable case (M. 2, p. 40) considerable defect is associated with high As. and nystagmus in a boy of 11 years (Arthur Mansfield). The father, an observant man, of some education, is quite sure that the boy's eyes were oscillating when only a month old. V. was only $\frac{6}{60}$ and 4 J. held close; there is As. of 5·5 to 6 D. in each eye, nearly all M.As. in R. nearly all H.As. in L.; but V. is scarcely, if at all, improved by glasses. Colour vision perfect. The patient is an intelligent lad with light hair and blue eyes, but not an albino; except that the choroid is pale in the y.s. and o.d. region there is nothing unusual, and certainly nothing positively unnatural, at the fundus. The father gave the following family history. Two of this boy's brothers, both with blue eyes, have nystagmus and bad vision; but two other brothers with brown eyes, and the three sisters (two with brown eyes, one with blue) have good vision and steady eyes. Several male cousins with blue eyes on the mother's side have the same defects, but the *males* with brown eyes and all the females have steady eyes. Here, until we have an opportunity of estimating the refraction in the patient's brothers and sisters (which we hope to do

that in a large proportion (more than one-third) of his cases of miner's nystagmus there were conditions, such as corneal opacity, &c., causing defect of sight, and he concludes that any existing defect of acuity will predispose to nystagmus. I have not been able to learn much either from published or private sources about the effect, if there be any, that the nystagmus itself has upon the vision of miners whose sight was good when this condition set in. Dransart (Ann. d'Oculist. t. 88, p. 150, 1882) states that V. was below normal $\left(\text{between } \frac{2}{3} \text{ and } \frac{1}{6}\right)$ in half his cases, but it is not clear that he excludes such causes of defect as Nieden refers to. Mr. Snell of Sheffield tells me that he has never been able to refer defective vision to the effect of nystagmus in miners.

To face p. 366–67.

Pedigree of Family with Amblyopia and Nystagmus occurring only in Blue-eyed Males (illustrating Case XVII in Text).

All marked with asterisk (*) are affected.


nothing known further back.
daughter
daughter
All his relations dead, and nothing known of them.
?*Son,† Morris.
12 children as under
1. Daughter, Mrs. Nye. Blue eyes, steady.
Seven children, all blue eyes and all steady. Two sons. Five daughters. (The father also has blue eyes.)
Two children. 1. Son, brown eyes, steady. *2. Son, blue eyes, nystagmus.
2. Daughter, Mrs. Stunt. Brown eyes.
Five children. *1. Son, blue eyes and nystagmus. 2.} Sons, brown eyes, 3.} steady. *4. Son, blue eyes, nystagmus. 5. Daughter. Steady.
3. Son, Joshua Morris. Brown eyes, steady.
4. Daughter, Mrs. D. Is dead.
Three children. Two daughters, steady. One son, blue eyes, steady.
5. Daughter, Mrs. Stevenson. Blue eyes, steady.
Four children. 1. Son, brown eyes, steady. 2.} Daughters, brown 3.} eyes, steady. 4.}
6. Daughter, Rebecca, died single.
7. Son, Edward, died single.
8. Daughter, Elizabeth, died single.
9. Died young.
10. Daughter, Mrs. Mansfield. Brown eyes, steady (see text).
Eight children. 1. Daughter. Brown eyes, steady. *2. Son. Died; meningitis; blue eyes. Nystagmus. *3. Son, Arthur (Case XVII in text). Blue eyes. Nystagmus. 4. Daughter. Blue eyes, steady. 5. Daughter. Brown eyes, steady. *6. Son, Ernest (Case XVII in text). Blue eyes. Nystagmus. 7. Son, George (Case XVII in text). Brown eyes, steady. 8. Son, Walter. Brown eyes, steady. (Father of this family not related to mother. See text.)
11. Died young.
12. Son. Wm. Morris. Brown eyes, steady. No children.

† This ancestor was a Welshman; he was in business, and was able to speak seven languages. He was for a time insane in Bethlem Hospital, but quite recovered. Accounts differ as to whether he had nystagmus.

shortly), we cannot say whether the two defects—nystagmus and amblyopia—are always correlated or not.

P.S., July 21. Since the lecture was given we have seen the patient's two brothers. One (Ernest, aged about seven) has blue-grey irides, nystagmus, and high H. As. (R. H. 7·5 D. horizontal, 5 D. vertical; L. H. 6 D. horizontal, 3·25 D. vertical.) The other (George, aged five) has brown irides, no nystagmus, and is almost Em. in both eyes (H. about 0·5 D.). Thus high As. seems to be associated with the nystagmus and amblyopia, and with blue irides. The mother has brown irides, V. $= \frac{6}{6}$ and H.m., only 1 D.; the father also has V. $= \frac{6}{6}$ with H.m. 1 D.

Dr. Wilmot Herringham, who took most of the foregoing notes, has also drawn out the accompanying family "tree."

Group 6.—In albinos we find another natural group of persons who usually suffer from defective acuity of vision and nystagmus, neither condition being, so far as I know, associated in them with any particular kind of refraction, though nearly all are more or less ametropic. But that albinism is not necessarily accompanied by amblyopia, and that, on the other hand, an albinotic infant may seem almost totally blind, the two next cases show.

Case XVIII.—Charles H., æt. 28. Moustache almost white; hair very light (says it was much lighter when a child); irides bluish-grey, red light from fundus transmitted through them both by daylight and focal illumination. V. good $\left(\frac{6}{6}\text{ partly}\right)$. No intolerance of daylight, and no nystagmus observable in daylight, but ophthalmoscopic examination causes both in a slight degree. Has three sisters and two brothers all of the same complexion as himself, but none have made any complaint about their eyes. The patient himself comes for a phlyctenular attack.

Case XIX.—Saml. M., æt. four months. Hair and lashes white; thought not to see. Constant lateral slow nystagmus; irides light blue. Ps. only slightly pink; act well to light, and

after homatropine measure 5·5 mm. Fundus perfectly normal so far as seen, but optic discs not well examined. Child does not with any regularity look at the light. Head well formed—neither too large nor too small; fontanelles open; sucks well; no fits.

You will observe that the cases in *Groups* 5 and 6 are nearly all ametropic, and have complained simply of bad sight, *i.e.*, defective visual acuity or *imperfect perception of form.* We are sometimes met by complaints, chiefly in reference to *light*, the most usual difficulty being *night-blindness*, shown by contraction of the field and lowering of the acuteness of vision by dull light. I may remind you that night-blindness is always present in the so-called retinitis pigmentosa, and almost always in syphilitic retinitis, that night-blindness without ophthalmoscopic signs occurs in "snow-blindness" (temporary exhaustion of a sound retina by too much light) and in "endemic" or "functional" night-blindness (exhaustion of a badly-nourished retina by prolonged exposure to light that would be borne with safety by healthy eyes).* The latter form is now rare in our country, but was common here in the days when scurvy was common, and is still common in sunny lands. Night-blindness is sometimes a marked symptom in chronic glaucoma (exhaustion of a retina badly supplied with blood, increased intra-ocular tension causing unnatural resistance to the entrance of the arterial stream), but is usually masked by the other symptoms. In hysterical amblyopia there is also increased difficulty by dull light. The same symptom is often mentioned by very myopic persons.

In respect to common retinitis pigmentosa, it will suffice here to remember that though depending on inherited peculiarities, it is probably not present at birth;

* Probably a slight degree of general retinal exhaustion accounts for patients occasionally telling us that they get to see worse after being for some hours in the open air; the difficulty as stated to me has been chiefly noticed whilst driving.

that once begun it almost invariably goes on slowly to blindness, its later stages being often complicated with posterior polar cataract and incurable progressive deafness; that it affects both sexes,* and is often associated with mental or other nervous defects in the patients or their relatives; that there is often a family history of the disease in previous generations, and that consanguinity of parents is believed by many to be an important factor in its production; and that however low the acuteness of vision and light-perception may be, there is no colour-blindness.

Group 7.—Probably closely allied in pathogeny with true retinitis pigmentosa, and certainly not distinguishable from it if we consider only the actual subjective symptoms, is a form of disease which differs from it, so far as my experience carries me, in several important points. In this malady the night-blindness is stated to have been present from the earliest childhood, seems to be stationary (though more experience is needed before this can be asserted), and does not appear to have the same pathological associations as the other disease, and none of the patients are deaf. The ophthalmoscopical appearances are different from and much less conspicuous than in the common disease, consisting chiefly in irregularity of the pigmented epithelium, and the presence of scattered minute white dots. I brought four cases of this malady (in two pairs of sisters) before the Ophthalmological Society in the present session, but I have notes of several others, one of the most remarkable being that of a little boy, named Howland, whose mother brought him because she had found his sight was defective at night, as it was in a number of his male relations. She was particularly distinct in her knowledge of her family, and gave us the facts for constructing the accompanying remarkable pedigree, from which it appears that no less than 22 members are affected in the same way, that they are all males, and that the

* But according to statistics collected by Leber, very unequally, 150 cases giving 110 males and only 40 females (Graefe u. Saemisch, v, p. 655).

great majority (16 out of 22) inherit through the mother The defect is said to be stationary in all of them, at any rate several are middle-aged, and none are known to have gone blind. In all of them night-blindness is the chief symptom. One of them, A. Beckley, has lately, it is said, had to move from a village into a town (Maidenhead) because he used to lose his way in the roads at night.

The child's case is as follows:—

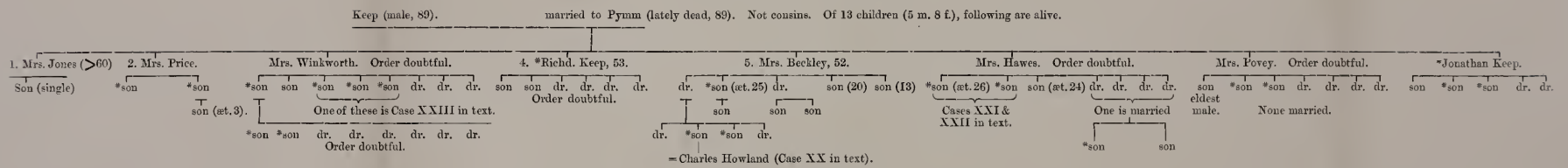
Case XX.—Chas. Howland (P. 6, 117, see pedigree), was brought to the Hospital for Sick Children in March, 1882, because he saw so badly at night that his mother could not trust him to go about alone, even in the house. He was a healthy, intelligent little boy of five, and was able to spell words 6 Sn. at 6″; the R., however, deviating and oscillating. No definite ophth. changes were seen. He passed Holmgren's colour test perfectly well. Refraction not stated. He is the second of four children; the first, a girl, has no defect; second (the patient) and third, boys, are both affected; fourth, a girl aged only 12 months, believed to see well. A year and a half later (September, 1883) he was getting on pretty well at school. I now made out that there was M. of about 4 D. in each eye, and that the choroid at central regions was "very granular and pale as if from disease of the epithelium." We saw him again a few days ago (May 18, 1887); he is now 10, a bright but rather shy child, seeing $\frac{6}{18}$ with −4·5 or 5 D., and reads 1 J. easily. There is a great difference in the refraction at the y.s. (M. 4·5 to 5 D.) and the periphery (H. 2·5 to 3 D.); there are fine, pale, ill-defined dots of superficial choroidal change around the y.s., the y.s. itself appearing healthy, and a few scattered larger spots of pigment towards the periphery; o.d., and vessels n. All the changes are slight in degree, and are not suggestive of syphilitic disease.

I have only succeeded in examining (not very thoroughly) three of the other affected relatives, viz.:—

Case XXI.—Henry Hawes æt. 26 (see pedigree), who with −11 D. sees $\frac{6}{18}$ with R. and $\frac{6}{36}$ with L., and has no definite

To face p. 370–71.

Pedigree of Family with Amblyopia and Night-blindness occurring only in Males (illustrating Cases XX to XXIII in Text).
Those marked with asterisk (*) are either known or reported to be affected.


Keep (male, 89). married to Pymm (lately dead, 89). Not cousins. Of 13 children (5 m. 8 f.), following are alive.
1. Mrs. Jones (>60)
Son (single)
2. Mrs. Price.
*son
*son
son (æt. 3).
Mrs. Winkworth. Order doubtful.
*son son *son *son *son dr. dr. dr.
One of these is Case XXIII in text.
*son *son dr. dr. dr. dr. dr. dr.
Order doubtful.
4. *Richd. Keep, 53.
son son dr. dr. dr. dr.
Order doubtful.
5. Mrs. Beckley, 52.
dr. *son (æt. 25) dr. son (20) son (13)
son son son
dr. *son *son dr.
= Charles Howland (Case XX in text).
Mrs. Hawes. Order doubtful.
*son (æt. 26) *son son (æt. 24) dr. dr. dr. dr.
Cases XXI & XXII in text.
One is married
*son son
Mrs. Povey. Order doubtful.
son *son *son dr. dr. dr. dr.
eldest male.
None married.
*Jonathan Keep.
son *son *son dr. dr.

ophth. changes except crescents and perhaps pallor of discs. He has quick lateral nystagmus when looking sideways; he sees worse at night than by day; he is sharp in answering questions, and seems intelligent; a shoemaker. No colour-blindness.

Case XXII.—H., a rather younger brother of the last (see pedigree), is excitable, liable to fits, and getting demented. He is very myopic and, like the last case, shows no decided changes. He is said to see worse at night.

Case XXIII.—H. Winkworth (see pedigree), a cousin of the last, is also myopic and sees badly at night, but shows no ophth. changes; he seems stupid, but may be only shy.

None of these patients are deaf.

I hand round the pedigree of this family so far as it could be ascertained.

Case XXIV.—R. B. æt. 11 (P. 7, 190). His parents not cousins. He is the third of four children (all living); the other three are sisters and have good sight. No neurotic history, and no other cases of night-blindness known in the family. Not deaf. He presents no signs of inherited syphilis. His sight is much worse at night than by day, so that he stumbles against things. No definite ophth. changes, except large M. crescents. V. of each $\frac{6}{18}$ with $\frac{-6 \text{ D. } 3}{-1 \text{ D. Cyl.}}$ F. somewhat contracted, even in daylight; not getting worse. Four years later V. as before.

Case XXV.—Herbert Batten, æt. 21, certificated teacher (March, 1887). Complains of short sight, of difficulty in seeing things "downwards," and of very definite night-blindness. V. R. $\frac{6}{60}$ $-2{\cdot}5$ D. $= \frac{6}{9}$ partly, 1 J. at 36 cm. L. $\frac{6}{60}$ $-2{\cdot}5$ D. $\frac{6}{9}$ partly, 1 J. at 36 cm. Ophth. changes symmetrical. Discs rather pale, especially L.; very narrow crescent; arteries and veins somewhat diminished. At yellow-spot region the epithelial layer is absent or very coarsely granular over an area about half the size of disc; the surrounding choroid is slightly granular. Extensive uniform surface changes at periphery, epithelium being removed in some parts, and coarsely granular

in others; in many parts an appearance of minute elevations, probably "colloid" bodies. A few scattered coarse pigment spots, but no pigment, along vessels or in retina. On measuring his fields by various degrees of subdued light compatible with a full field in a normal eye (check observations made), they were found contracted in direct proportion to the illumination. No known family history. No signs of hereditary syphilis.

Case XXVI.—George Maben, æt. 16 (St. Thos. O.P. papers, 1886), has had difficulty in seeing at night as long as he can remember, and dare not go into an unlighted road by himself at night; the defect, however, is not getting worse. His visual acuteness is $\frac{6}{18}$ with each eye, not improved by glasses, and he reads 1 J.; Fs. (by gaslight) show a slight amount of concentric contraction. Ophth. appearances perfectly normal in every particular. Intelligent, and is not deaf. No family history of similar complaint, and no consanguinity of parents. Father's father was for a time in an asylum, but quite recovered.

The early presence and apparently stationary character of the symptoms in this group of cases, suggests that the choroido-retinal changes, which were more or less noticeable in all except the last, took place during intra-uterine life.*

Group 8.—In the last series we have to examine, we find a defect complementary to that last considered, day-blindness instead of night-blindness. The patients are always amblyopic and colour-blind (usually for *all colours*). Their difficulties are dated from birth, and are stationary. I recorded several cases of this peculiar disease under the title of "Congenital Day-blindness with Colour-blindness" some years ago.† Since then I have met with some others, and as the subject has, I think, not been sufficiently attended to, I propose to narrate them.

* Leber (in Graefe u. Saemisch, vol. v, p. 648) gives a short account of congenital night-blindness without retinitis pigmentosa, and with only slight changes. His description agrees in some respects with the cases which I have narrated in this lecture.

† St. Thomas's Hospital Reports, vol. x, 1880.

Case XXVII (P. 4, 150).—This family (Mrs. D.'s children) was kindly sent to me by Mr. Waren Tay in September, 1880. There were five children; the eldest a boy, the other four girls. The two eldest girls (Nos. 2 and 3 in the family) were day-blind, totally and completely colour-blind, and moderately amblyopic, seeing about $\frac{20}{70}$ with their H. of about 3 D. corrected. No definite ophth. changes. Irides gray-blue; hair auburn. Patients' health good. No cases of same kind known in other branches of family. Parents are first cousins. The two youngest children were believed to see well, but as they were less than seven years of age, and we had no opportunity of seeing them, we cannot feel certain.

Case XXVIII.—John Jones, æt. 22 (M. O. 1, 120), a fairly intelligent labourer, from Wales, says that his sight has never been better than at present. He dislikes bright light, sees better in winter than in summer, and sees better in December, in London, than when he is at home.

On admission at Moorfields, in December, 1883, Dr. Thynn found that he had Hm. 3 D. in R., and Hm. 4 D. in L., with V. $= \frac{6}{24}$ in each eye. He was wearing +5 D. There were no ophth. changes, except doubtful congestion of the discs. He was aware that he could not distinguish colours as other people could; on trial we found that he judged almost entirely by shade, all pale colours being "white," and all dark ones "black," and that he was ready to match green with nearly all other colours; blue was the only colour which he promptly picked out by name, but even this colour was often confused with several others, including yellow. The visual fields seemed contracted; but as they were taken only once, and he did not understand English well, I do not attach much importance to the result.

One of his sisters is said to have eyes "exactly the same as" the patient, and to wear the same glasses. He has three other sisters and two brothers, all of whom see well, and without glasses. No consanguinity, and no similar cases are known in other relatives, though enquiries have been made.

Case XXIX.—Mary Abbott, æt. 55 (M. O. 1, 236) came to

Moorfields in August, 1885, when we found that she had H. 4 D. in R., and H. 3 D. in L., V. being only $\frac{6}{60}$ in each when corrected, and only 16 J. with the aid of +6 D. She had used +4 D. for the last 12 years. There was slight haze of o.ds., and thickening of arterial sheaths, but not more than is common in normal, and especially in H., eyes. There was well-marked red-green blindness, but the notes make no statement as to other colours.

She said that her sight had never been better than now; she had never been able to see small print, and had for many years been aware that she could not tell colours properly, except black, which she considered herself a good judge of. She said she could see much better in a dim than in a bright light; that she did not like going out in sunlight; and that in the kitchen (she was in service) she always liked to keep the blinds down in the daytime, since if they were drawn up she was liable to knock things down and break them, because unable to see.

Her own health had been pretty good. Her parents were first cousins, and both died when patient was young; she believed that their sight was good. She had one brother, who seems to have had good sight; he was a soldier, and died in the Crimea.

Case XXX.—Miss Schwarz (T. O. 3, 90, 1881), æt. 36. Parents were first cousins. Had cataract in the L. eye, and was operated with good result six years ago. I saw her again yesterday (May 24, 1887). The condition of the other (R.) eye in 1881 was as it is now, as follows:—V. with −2 D. = $\frac{6}{24}$ badly. She wears −1·75 D. ordered several years ago. Ophth. negative. She has nystagmus. She dislikes sunlight, and sees better in the dusk. Colour-vision:—She is bright, intelligent, and observant, and very anxious not to appear colour-blind, but she half confuses grey with green, mauve with purple, and scarlet with dark brown; she almost matches light violet with various yellows. Asked to pick out the yellows, she has no idea of them, though she manages after much hesitation to pick out fairly well most of the other colours by name. Her sister (Mrs. B.), whom we saw and tested, has exactly the same conditions, but with much higher M. (8 D.).

Case XXXI.—James Jacob, æt. 16 (T. O. P., loose paper), (3/6/84). Nystagmus rapid and horizontal from birth. "Very near-sighted;" does not like the sunlight, but no definite day-blindness; no history of ophthalmia neonatorum. V. with both 6 J. at 2″ and $\frac{2}{60}$ by nipping lids together. Hm. 2 or 3 D. but V. not improved.

Parents said to have good sight; no consanguinity. The patient is the second of five children (the four eldest, boys, the fifth, a girl), all born at full time, and still living; infantile history negative. Patient has been in a workhouse since seven years old, on account of his bad sight, but in spite of his difficulty has become one of the teachers in the school! The third child (M., æt. 14) is in the same workhouse, and said to be colour-blind and to see badly; but the three others (viz., the first, fourth, and fifth) see well. Although the patient said that he could "tell colours well," we found that he really had no colour-perception at all, for he confused blue with yellow, and scarlet with very dark green.

The following are the previously published cases of this condition which I just now referred to:—*

Case XXXII.—The F. family. Miss Mary F., æt. 25. V. $\frac{20}{200}$ and 6 J. at 4″; Em.; p.s. n.; nystagmus; ophth. doubtful haze about y.s.; f.n. Sees much worse by day than at night; in the day is afraid to cross the street, at night can do so easily, and can read small print when light is so dull that other people have to put away their books. Total complete colour-blindness to wools; always dresses in black and white, to avoid making mistakes. All the conditions are stationary. She is eighth of a family of 11, six males, five females. Of this number five besides herself have the same defects of sight, two being males, and three females; two of these (a brother and sister) were seen, and found to have exactly the same conditions. Family history negative but incomplete; an uncle said to be colour-blind for red and green.

* Nettleship, *loc. cit.*, Cases I, II, III, and IV.

Case XXXIII.—Boy, æt. 16. Moderate amblyopia, low M.; total complete colour-blindness, small nystagmus; sight much better by dull light; ophth. signs of slight previous central choroido-retinitis. All the symptoms present from birth. No other cases in family of five. Was born in state of suspended animation, and only brought round by artificial respiration; eyes were red for some days after birth.

Case XXXIV.—The P. family. Two brothers, æt. 15 and 13, with V. $\frac{20}{200}$, and some H.; nystagmus; total complete colour-blindness; sight better in dusk than by day; ophth. quite n.; childish and backward, but not imbecile. Two others in same family (female, æt. 7; male, æt. $3\frac{1}{2}$) quite blind, and quite idiotic, and in the younger of these discs "dirty yellowish-white." Two others (female and male), intermediate in the family, have perfect sight and good intelligence. Parents first cousins.

Case XXXV.—C. family. Here there were three children; first, female, æt. 6, with nystagmus; V. = 12 J. held close; sight much better in dusk; total complete colour-blindness, and no ophth. changes; second, æt. 4, nystagmus and sight defective; ophth. negative; third, æt. 1 year, well marked nystagmus; can see, but probably not well; no ophth. examination. Parents not cousins.

These two families (Cases XXXIV and XXXV) were related, being first cousins once removed. The full pedigree is given in the original paper.

In this peculiar group there is no great preponderance of either sex, many being females. Consanguinity has been very common. All are colour-blind, and not only for the ordinary colours, red and green, but for blue and yellow, *i.e.*, "totally" colour-blind; the colour-blindness may, however, be "complete" or "incomplete." The ophthalmoscopical changes are quite insignificant, whilst in the night-blind series (*Group* 7) widespread changes were usually found. High errors of refraction are not usual. I have as yet seen only one *totally* colour-blind person (curiously

enough a woman) who was not amblyopic, and only two or three (P. 11, 250; P. 12, 7; M.O.P. 2, 7) who were not decidedly day-blind. Indeed, I believe that many of the cases of total colour-blindness recorded in literature have belonged to this day-blind group, and that cases of total colour-blindness without other defect of sight are excessively rare.

Cases of amblyopia and day-blindness with total colour-blindness have been recorded by Donders (Heidelberg Congress, 1871, referred to in Jeffries' "On Colour-blindness," p. 35), Landolt ("Examination of the Eye," p. 191), Magnus (Hirschberg's Centralb., 1880, p. 373), Dor (Revue Générale, t. iv, p. 433, 1885; day-blindness not mentioned, but considerable amblyopia), and doubtless by others. I do not find the subject mentioned by Nuel in his short chapter on Day-blindness in Wecker and Landolt's Traité, t. 3, Fasc. 3, nor in Graefe u. Saemisch's Handbuch.

You will notice in regard to the forms of amblyopia discussed to-night, that in all of them both eyes were equally affected, and that in most there was a strong family history either in the same parentage, or in collateral branches. The conditions, therefore, though differing in the various groups, are probably due to developmental defect; or to transmitted, rather than to merely personal, disease.

Lecture III.

A number of cases remain over in which defect of sight without any sign of disease is confined to one eye.

Though in these cases the patient (who is usually grown up) often thinks the defect recent, we find no evidence of this, unless the case prove to be retrobulbar neuritis, hysterical amblyopia, or damage to the optic nerve from injury to the orbit or head; and whilst cases of apparently causeless amblyopia of one eye are very common, the diseases just named are relatively rare.

In the cases I am about to speak of the direct reflex action of the pupil is natural, whilst it is more or less interfered with in retrobulbar neuritis and injury of the optic nerve. The defect of vision may be very trivial, or so high that only large objects can be seen; it may be perfectly remediable with glasses, in which case there is almost always anisometropia, and the defective eye is nearly always the more ametropic of the two; or only partly remediable by glasses; or glasses may not help at all. Though the eyes are now straight, there may be a history of convergent squint which has been cured by operation, or has disappeared without treatment; but in other cases we find no ground for assuming that squint ever existed. In others again convergent or divergent squint of the amblyopic eye is still present.

In cases of high anisometropia, without squint either past or present, we often find that though the more ametropic eye have not hitherto been corrected, yet with the proper glass it sees as well, or very nearly as well, as the better eye. The following are examples of this:—

Case XXXVI.—Mrs. H., æt. 45 (P. 13, 127). Has never had her R. corrected, having always depended upon her L. (the better) eye. R. $= \frac{6}{60}$, raised to $\frac{6}{9}$ by $\left\{ \begin{matrix} -9 \text{ D.Cyl.} \diagdown \\ +\text{D.S.} \end{matrix} \right.$ Reads small print with +9 D.Cyl.$\diagup$, better still with $\left\{ \begin{matrix} +9 \text{ D.Cyl.} \diagup \\ +4 \text{ D.S.} \end{matrix} \right.$ L. $= \frac{6}{18}$ well raised to $\frac{6}{9}$ by $-4{\cdot}5$ D.Cyl.$\diagdown 50°$. Here the difference between the eyes is equal to that between Em. in one and H. As. about 4 D. in the other. Separate correction does not permit the combined use of the two eyes, but she likes reading spectacles with a plane glass for R. and +4·5 D.Cyl. for L.

Case XXXVII.—A man, æt. 34, who had never worn glasses, had R. V. $\frac{6}{6}$ nearly, raised to $\frac{6}{6}$ well with $-0{\cdot}5$ D.Cyl. L. required $\left\{ \begin{matrix} +6 \text{ D.Cyl.} \\ -3{\cdot}5 \text{ D.S} \end{matrix} \right\}$ and then saw $\frac{6}{6}$ nearly.

Case XXXVIII.—Mrs. D., æt. 48 (P. 13, 214), is using +4 D.

R. = $\frac{6}{60}$ raised to $\frac{6}{9}$ by +4 D.
L. = $\frac{6}{24}$ raised to $\frac{6}{6}$ fairly by +1 D. } Difference = H. 3 D.

Separate correction of the two eyes for reading causes discomfort.

Case XXXIX.—Rev. T., æt. 48 (P. 12, 176), has worn −5·5 D. for several years chiefly for distance. The R. has My. 9 D., and corrected sees $\frac{6}{9}$ partly. The L. has My. 5·5 D., and corrected sees $\frac{6}{9}$ partly. He prefers the separate correction, and it is ordered.

In these and other cases too numerous to quote, the myopic patients have an advantage over those who are hypermetropic or highly astigmatic. The former have often unconsciously exercised the more myopic eye in reading, &c. But in the latter we cannot suppose the more hypermetropic or more astigmatic eye to have been used separately, unless on the assumption (for which I think we have but little warrant) of very unequal accommodation in the two eyes, and, in the case of high single astigmatism, of meridionally unequal accommodation in the astigmatic eye.

We find other cases of anisometropia, though in my experience they are less numerous than the former, where vision is not nearly equal in the two eyes when corrected, even though the difference between them be not extreme.

Case XL.—Miss R., æt. 43 (P. 13, 219), sees $\frac{6}{0}$ badly with her R., raised by +5 D. to $\frac{6}{12}$; with the L. she sees $\frac{6}{6}$ partly, and is very nearly emmetropic.

Case XLI.—Mr. R., æt. 20 (P. 12, 79), sees $\frac{6}{12}$ with R., raised

to $\frac{6}{6}$ by $\left\{\begin{array}{l}-5\text{ S.}\\-1\text{ D.Cyl.}-\end{array}\right.$; with L. he sees $\frac{6}{60}$, improved to $\frac{6}{18}$, but not beyond, by $\left\{\begin{array}{l}-3\text{ D.S.}\\-2\text{ D.Cyl.}\diagdown\end{array}\right.$

Case XLII.—Miss T., æt. 18 (P. 14, 174), has never worn glasses.

V.—R. $\frac{6}{0}$, raised to $\frac{6}{18}$ partly, $\frac{6}{24}$ well, by $\left\{\begin{array}{l}-9\text{ D.S.}\\-5\text{ D.Cyl.}\diagup\end{array}\right\}$; the eye often diverges and is probably never used: L. $\frac{6}{9}$ partly, Hm. 0·5 D. only, but ophth. shows H. = 5 D. It is true that here the anisometropia is extreme.

Very rarely in anisometropia the more ametropic eye sees the better, as in the following:—

Case XLIII.—Mr. H., æt. 37 (P. 13, 65), likes to cover L. in reading; cannot unite the images in an opera glass, and has diplopia for distance.

With the R. he sees $\frac{6}{12}$, raised by $-$ 1·5 D.Cyl. | to $\frac{6}{6}$, "better than left."

With the L. he sees $\frac{6}{9}$, raised by $\left\{\begin{array}{l}-\text{ 0·25 S.}\\-\text{ 0·75 D.Cyl.}\diagup\end{array}\right.$ to $\frac{6}{6}$.

Here the more ametropic eye is preferred, possibly because its chief meridians are vertical and horizontal, those of the other eye being oblique.

Case XLIV.—Mrs. P., æt. 41 (P. 13, 172), illustrates the same point.

V.—R. $=\frac{6}{12}$ partly, improved to $\frac{6}{9}$ partly, by $\left\{\begin{array}{l}+\text{ 1·5 D.S.}\\+\text{ 1 D.Cyl.}\diagup 45°.\end{array}\right.$

L. $=\frac{6}{12}$ well, improved to $\frac{6}{6}$ by $\left\{\begin{array}{l}+\text{ 2·5 D.S.}\\+\text{ 1 D.Cyl.}-\end{array}\right.$

Reviewing our cases of anisometropia, we may say that in many of them the vision of the two eyes can be equalised, and in many others approximated, by separate correction, and that cases of extreme quite irremediable defect of the more ametropic eye are very uncommon, unless there be or have been strabismus. Probably irregular astigmation (of the lens) accounts for such moderate

residual defect of one eye as is illustrated in Cases XLI and XLIV.

It is unnecesary to quote cases of defect associated with existing convergent strabismus; vision in the squinting eye is, as every one knows, nearly always defective, unless the squint be alternating, though the degree of amblyopia is far from constant. So common is the association, that when we meet with causeless amblyopia of one eye without existing strabismus, we may expect to obtain the history of a previous squint which has been cured, or has disappeared spontaneously as convergent squint not uncommonly does. No doubt in such the defective eye is usually more ametropic than the other, but this, as we have just seen, is not generally of itself any bar to good vision when corrected; moreover the amblyopia is often irremediable, and much more severe than it would be if due to ametropia only. In the two following cases there was a clear history of squint.

Case XLV.—Miss B., æt. 14 (P. 12, 144). Formerly squinted with her R., but there is now no deviation. The vision of R. is extremely bad,—19 J. and less than $\frac{6}{60}$, scarcely raised to $\frac{6}{60}$ by $-2{\cdot}5$ D.S., which corrects the (objectively measured) myopia. L. $= \frac{6}{9}$ raised to $\frac{6}{6}$ by $-0{\cdot}5$ D.S.

Case XLVI.—Dr. R., æt. 75 (P. 12, 103). Squinted badly with his L. when a child, and his mother used to box his ears to make him look straight. The squint disappeared, but the eye has never got to see. The R. sees well, and is nearly Em.; with the L., which does not now squint, he can see fingers in the temporal side of the field, but nowhere else, and the ophthalmoscope shows hypermetropia of $2{\cdot}5$ D.

Sometimes the patient, now grown up, though remembering that he used to squint, may not be able to tell which was the offending eye, and we assume that it was the one now found, or known to be defective. For instance—

Case XLVII.—Mr. T., æt. 45, knows that his L. has always seen badly, and that he formerly squinted inwards, but cannot say with which eye; at present R. sees $\frac{6}{6}$, and is Em. L. cannot see $\frac{6}{60}$ with or without glasses; refraction H. about 2·5 D. with some As.

Case XLVIII.—Mrs. H., æt. 38 (P. 12, 125), knows that R. has seen badly since childhood, and that she used to squint, but does not know with which eye; there is now no squint. R. sees board, but cannot count fingers; H. 6 D. by ophth. L. $\frac{6}{9}$ H.m. = 2 D. H. by ophth. = 3 D.

Such cases show that when a squinting eye sees badly, the return of the eye to its natural position, and therefore the exercise of the yellow spot of its retina with the yellow spot of the other eye has not resulted in any improvement of the sight.

We meet also occasionally with irremediable defect of one eye, in grown persons, not explained by anisometropia and without any history of former squint. From my own experience I cannot as yet consider it proved that the absence of history of squint in these instances is trustworthy, for I have not hitherto observed any cases of high defect of one eye, in *children*, with neither squint no anisometropia, and I think that any cases of the kind would deserve careful record. It is, however, very generally held that the vision of one eye may be highly defective from birth or early life without visible cause, without extreme anisometropia, and without previous or existing strabismus. I have notes of very few cases at all in point; of the three following the first is only moderately well marked, and the other two are quite exceptional:—

Case XLIX.—Mr. B., aged 20.

Vision.—R. $\frac{20}{0}$ −1 D. $\frac{20}{70}$. Ophth. = H. 1·5 D. If he looks

at any object with this eye, *whatever may be its distance*, it soon "fades," "goes dark" and becomes "invisible." In reading, he moves the object about as if there were a defect in the field, yet none can be found.

$$\text{L. } \frac{20}{70} - 1 \text{ D.Cyl.} = \frac{20}{20} \text{ partly; Ophth. H.} = 2 \text{ D.}$$

After atropine;

$$\text{R. } \frac{20}{100} + 1 \text{ C.} \left| \begin{array}{l} \\ + \cdot 75 \text{ S.} \end{array} \right\rangle = \frac{20}{50}.$$

Careful ophth. examination shows no change.

$$\text{L. } \left. \begin{array}{l} + 1 \text{ D. C.} \\ + \cdot 75 \text{ S.} \end{array} \right\rangle = \frac{20}{20} \text{ partly.}$$

He found out the defect of the R. several years ago; when beginning to shoot (from the R. shoulder) about æt. 16, he found that he shot to one side of the bird, and he had to learn to shoot from the left shoulder. He has binocular vision for long and short distances, and always gets diplopia with a vertical prism. Careful examination shows that there is no squint, and his father (a medical man) assures me that to the best of his belief there never has been any.

Case L.—Patrick Martin, æt. 20. *Congenital Paralysis of Third Nerve with Defect of Limbs on the same side, and extreme Amblyopia of the corresponding eye.* R. p., 1·75 mm., motionless; dilates to 4·5 mm. under atropine; wide divergence; iris looks healthy; in trying to look to left, eye goes up (but scarcely reaches middle line), and its vertical axis rotates inwards; ptosis nearly complete, fissure about 6 mm. wide at most, without the help of the occipito-frontalis; sees hand, but cannot count fingers; fundus normal; refraction myopic, but degree not measured. L. p. too large (about 6 mm.), acts well to lt., very little to acc.; V. $\frac{20}{0}$, -5 D. $= \frac{20}{50}$ partly; 1 J. at 5″, and, with -2 D., at 15″. The history is incomplete. His mother states that the patient when a child used often to shut one eye when looking steadily at things (? diplopia). No history of hemiplegia, but the doctor said, when the boy was 4, that he was "slightly paralysed" in the R. side. This was when the deformity of foot began. Is under Mr. Pitts for Talipes clavus of R. foot.

Case LI.—*Congenital Paralysis of Third Nerve, with Hemiplegia on same side; Amblyopia of corresponding eye without changes.* Edith Gamman (T. O. 3, 173). Paralysis of R. limbs and R. third nerve when aged 2 days; later, arrest of growth of R. hand and of R. eye (causing anisometropia) and high amblyopia of the same eye. *Present condition:* R. H. 4 D. V. not $\frac{6}{60}$, and not improved by glasses. L. H. 1 or 1·5 V. with + 1 D. = $\frac{6}{18}$ (probably sees more); ophth., no definite changes; vessels in R. more tortuous and larger than in L.

We are now ready to glance at the two different explanations which have been offered of the defect which has been spoken of in convergently squinting eyes. (*a.*) It is assumed on the one hand that all healthy children are born with the double visual apparatus (eyes and centres) equally good as regards perceptive power; that convergent squint coming on (nearly always owing to hypermetropia), double vision occurs; that to get rid of this the child suppresses or neglects the consciousness of the image in the squinting eye; and that suppression or neglect, if continued, leads to permanent defect. This is the theory of "visual suppression," "amblyopia ex anopsia." (*b.*) By another school it is held that in some children the perception of form, at birth, is not equally good upon each side (in each eye or each visual centre); that some such children being hypermetropic are compelled to squint, and that they then of course choose the better eye for use, and therefore the defective one for squinting. This is the theory of "congenital defect." The former theory assumes that if the need for suppression of the image can be removed before the defect has been present too long, or has reached too high a degree, the defective eye can be improved and binocular vision restored; and this doctrine must lead to the adoption of early operations for convergent squint, and of separate practice of the squinting eye in order to prevent or remove the defect. On the other hand, if the second

theory be true, we should not expect the defective eye to be improved, either by separate practice, or as a consequence of tenotomy, however early in life the operation were done.

What is there to be said in favour of the suppression theory? In the first place repeated temporary suppression or neglect by an eye seeing well is common, occurring in all who, though seeing well with each eye, do not enjoy binocular vision. Indeed one of the first points that strikes us here is that the function of binocular single vision is in a great degree independent of the acuteness of the sight of each eye. Although probably the power of good, and especially of equal, visual acuity with each eye is a powerful incentive to fusion, *i.e.*, to a single consciousness derived from the two retinal impressions, yet we meet with some who have good fusion power (binocular vision), in spite of the vision being different in the two eyes, and with others who though affected with squint, and having perfect vision in each eye, yet never see double, *i.e.*, constantly suppress one image. The following illustrative cases may be quoted.

Case LII.—Mr. H., æt. 48 (P. 14, 158). Has binocular vision (proved by diplopia always occurring when a prism is held base up or down before one eye) both for long and short distances, when his anisometropia is corrected (and no doubt also when it is not). His optical condition being—

$$\text{R. } \frac{6}{9} \text{ raised to } \frac{6}{6} \text{ by } \begin{cases} -\cdot 5 \text{ D.S.} \\ -\cdot 5 \text{ D.Cyl.}— \end{cases}$$

$$\text{L. } \frac{6}{24} \text{ or } \frac{6}{18} \text{ partly; } \frac{6}{9} \text{ well with } -1\cdot 5 \text{ D.Cyl.} \diagdown 10°.$$

He has a latent deviation of L. slightly up and out.

In the next case the patient was able to use (and suppress) either eye indifferently.

Case LIII.—H. W. Lyons, æt. 29 (M. O., loose letter), appears to suppress or neglect totally and instantaneously with either

eye. He has a slight divergent squint, almost alternating, but usually affecting the L., which has he thinks been present "all his life." He is emmetropic, and has full vision ($\frac{6}{6}$ and no Hm.) in each eye, and never sees double.

But in the following cases the power of suppression was apparently limited to one eye, and in the first of them we were able to prove that the suppression occurred only in the part of the field which is common to the two eyes.

Case LIV.—Mr. L., æt. 17 (P. 3, 160), with muscular asthenopia and slight divergence after tenotomy for convergent squint of R. 10 years ago, uses his L. eye, and does not see double, although vision is $\frac{12}{10}$ with each eye. That he habitually suppresses the R. is proved as follows. When both are open, and he is looking at a distant object, he notices no difference if the R. be covered; but if, when both are open, the L. be covered, the object at once moves, and if the L. be now uncovered, the object moves back to its former position; the suppression, however, occurs only in the central and inner part of the field (of R. eye); for when both eyes are open, and looking straight forward, the fingers are seen by the R. (or suppressing eye) when placed so far in the temporal part of its field as to be entirely hidden from the L. eye by the nose.

Case LV.—Mr. M., æt. 26 (P. 3, 38). Has vision $\frac{6}{6}$ in each eye, and no Hm. He can allow his R. to diverge widely at will, whether he is looking at near or distant objects. He has binocular vision whenever he chooses to converge, but is never conscious of diplopia when he allows the R. to diverge.

Case LVI.—Mr. S., æt. 38 (P. 13, 39), has M. of 4 D in each, and ·5 D. of As. in the L., which as he has convergent squint determines the R. as usually the "fixing" eye. The date of onset of the squint is doubtful, but is probably far back, as he says he could never use an opera-glass or stereoscope. He has V. $\frac{6}{6}$ in each eye when corrected, and he squints inwards

(usually with L.) for all long distances without ever seeing double. The L. suppresses so completely that if a red glass be put before this eye (both being open) he does not know it, though the object is at once made "red" if the glass be changed to the R.

In the next case, though suppression power exists in only one eye, the one which most often squints, the squint can be made to alternate at will.

Case LVII.—Mr. P., æt. 35 (P. 1, 84), has M. 6 D. in each, with ·75 D. of As. in the L., and sees a little better with the R. He has convergent strabismus almost alternating, but prefers to fix with the L. (less perfect) eye, and squint with R (*sic*). When doing so (*i.e.*, squinting with R.) he has no diplopia, or only a slight "confusion," but he can at will, by a little management, fix with the R. (squinting with L.) and then at once sees double.

In most cases vision is transferred *instantaneously* from one eye to the other in these cases of suppression without defect. But occasionally (perhaps more often if we examined with care) an appreciable time is needed for the process.

Case LVIII.—Master McE., æt. 11 (P. 5, 14), has vision $\frac{6}{6}$ in each, with Hm. and Ht. 1·5 D. in each, and varying convergent squint of L. (almost alternating however) without ever seeing double. When the R. ("working" eye) is covered, he at first "cannot see anything" on the distant board with L.; but in a few seconds he begins to read, and ends by seeing $\frac{6}{6}$ very nearly as well as with R. Another time, when L. began to fix, he exclaimed that the board looked "all dark" for a moment, gradually getting "lighter" till he could see the letters. As he only had 1·5 D. of hypermetropia in each eye, the above phenomenon seems hardly to be explained on the theory that the accommodation of L. was usually relaxed when both eyes were open, and had to be got into use when the L. became the "fixing" eye. More probably it points to a slowness of perception in the comparatively little used visual centre for the L. eye, and is perhaps only one variety of the difficulty in

using a habitually squinting (though not amblyopic) eye to which further allusion will be made.

Not only is temporary suppression a common thing, but at any rate in some persons it affects the field in just the same way as does the permanent defect found in cases of squint, viz., the temporal part, as in Case LIV, given above. In high defect with squint it is well known that the defect is often present only or chiefly in the binocular part of the field, vision remaining best in the temporal part; though we often meet with cases where the field of the defective eye appears of full size to ordinary tests. Of the former statement, the following illustrations may be given:—

Case LIX.—Mr. R., æt. 19 (P. 6, 155). Has slight vertical convergent squint of R. with high defect and anisometropia, the R. seeing only $\frac{6}{36}$ with $+ 2{\cdot}5$ D.Cyl. $-$; the L. $\frac{6}{6}$ with $\left\{\begin{matrix} -1{\cdot}5 \text{ D.S.} \\ -{\cdot}75 \text{ D.Cyl.} \end{matrix}\right.$ He fixes badly with R., and in looking at the "Astigmatic clock" he sees only its outer-upper part; the rest he can hardly see; a white spot is seen worst rather below and outside the fixation spot.

Case LX.—Mr. D., æt. 29 (P. 14, 168). R. nearly blind (and now widely divergent) "from age of 2 years," when both were inflamed (probably ulcers and ophthalmia); the eye now diverges widely; p. larger than L., but acts almost as well to light and acc.; sees hand only, and that only at outer part of field; field absent except in downward and outer part, transition from blind to seeing part being as abrupt as in cerebral hemianopia; he only sees half of objects looked at with this eye; colours appear dull, but are not confused; ophth. absolutely negative; anisometropia is the only explanation; refraction H. 3 to 4 D. L. with $-0{\cdot}5$ D.Cyl. $= \frac{6}{6}$.

If the defect found in the squinting eye were congenital and unconnected with squint, we should expect, as already said, (1) that similar cases would be found in

children who do not squint, and never have done so; and (2) that the defect would be independent of refractive errors, and especially independent of unequal refraction in the two eyes; and (3) we should be prepared to meet also with defective perception of colour and light confined to one eye.* I have already given (at p. 382) the only cases I have that at all fulfil the second requirement, and they prove but little. In the absence, therefore, as stated at p. 382, of proof of cases of decided amblyopia of one eye without anisometropia, we see a ground for accepting the theory that the amblyopia commonly met with in squinting eyes is in some way the result of the squint; and to my mind this is the principal piece of evidence in support of the theory of suppression. The similarity just described between the condition of the field in temporary suppression and in permanent amblyopia is also, so far as it goes, in favour of the latter condition having been developed out of the former. An advocate of the theory of congenital defect might no doubt assume a correlation of development between the visual centre and the retina, and proceed to explain the rarity of amblyopia without squint (and its usual accompaniment, anisometropia) by claiming that imperfection of one visual centre (amblyopia) would, by this hypothesis usually be associated with incomplete formation of the peripheral organ (hypermetropia). But against this we might say that arrested growth (hypermetropia) does not imply arrested perceptive power, and quote many cases of unequal hypermetropia in which acuity of sight was (after optical correction) equal, or almost equal, in the two eyes (p. 378, &c.).

On the other hand, the indirect evidence is all against the suppression theory, and therefore in favour of the defect in question being congenital.

* Perhaps such cases do occur not uncommonly; the subject needs working out. Many persons tell us that objects appear "darker" or "lighter" to one eye than to the other; and a few cases of uniocular colour-blindness have been recorded.

Thus if both eyes be born with defective images, as in lamellar cataract, vision may be perfect after removal of the cause, even if this be not effected until many years after birth. Of this our house surgeon, Mr. E. T. Collins, has kindly given me the following, amongst several other, instances, from cases lately operated upon here:—

Case LXI.—Lilian W., æt. 11, before operation L. J. 16 $\frac{20}{200}$, after absorption by needling, with +12 D = $\frac{20}{30}$.

Case LXII.—Bertie M., æt. 17, before operation R. $\frac{20}{100}$. L. $\frac{20}{100}$. After operation (R. suction, L. solution) R. +15 D. = $\frac{20}{30}$ partly. L. + 14 D. = $\frac{6}{6}$ partly.

Then, use of such an amblyopic eye as we are now considering does not improve it, as we might expect it to do, at least in some degree, if the eye had once seen well and the existing defect were due only to suppression of consciousness. This is shown by the persistence of the amblyopia after the associated squint has disappeared (p. 382 above); and yet more conclusively by the fact that even enforced separate practice of an eye which has for long been defective with squint does not improve its vision (Cases LXIII and LXIV). Even with young squinting children, in whom we have been taught to believe that early separate practice of the squinting eye would be its salvation, I have not been able to convince myself that any improvement has followed the adoption of this tedious mode of treatment.

Case LXIII.—Thomas Wells, æt. 47 (T.). Tenotomy of R. internal rectus for squint when æt. 8; vision of this eye has been defective "all his life," and never any use.

Came Oct., 1879, with complete cataract in this (R.) eye of a year's duration with bad p. l.; p. acted perfectly, directly and

indirectly. Cataract extracted March, 1880; V. in June, with $+11\ D = \frac{20}{200} + 18$, spells 18 J., ophth. n. The L. subsequently became slowly cataractous, and for a considerable time between 1882 and 1884 was the worse eye of the two; yet the R., though fitted with proper glasses, did not improve. The L. was afterwards operated on and regained V. of $\frac{6}{12}$.

Case LXIV.—Non-improvement of an old defective eye, though compulsorily used for many years.

Hy. Knight (M. I.P., 1885, No. 386 and 1136), had an injury to the R. causing traumatic cataract when he was 16, and as the p. remained blocked by opaque matter, he had to depend entirely upon the L. eye, which had "always" been defective, and had been affected by squint when he was at school.

He came to this Hospital in March, 1885, when he was 30, having been obliged for the 14 years that had elapsed since the injury of the R. to depend entirely on the L. The condition was:—R., shrunken traumatic cataract occluding the p.; L., sees $\frac{6}{60}$, Hm. 4 D., but not improved; with + 6 D reads short words of 14 J. He had never used a glass for this eye, and before consenting to operate on the R., I ordered him +6 D. spectacles for the L., and told him to use them for a month. As no improvement was perceptible either to him or to myself at the end of that time, I removed the shrunken lens from the R. by solution, and three months later with this eye he saw $\frac{6}{12}$, and 1 J. with proper glasses.

If suppression early in life were a cause of permanent amblyopia, we should suppose that the same result would occur, at any rate in some persons and in some degree, in adults; yet we know that adults cannot learn to suppress, however long a paralytic squint, which came on comparatively late in life, may last. Thus:—

Case LXV.—Louisa R., æt. 53 (M.O., 2, 84), has had partial paralysis of the third nerve for at least seven years, but she still has diplopia.

Case LXVI.—Mr. P., æt. 61 (P. 5, 23), began to see double owing to paralysis of the L. external rectus, in September, 1880. The usual conditions were present when I saw him in the following February; and again $5\frac{1}{2}$ years after the onset (in February, 1885), there was still considerable convergent squint, and the diplopia was as troublesome as at first.

Case LXVII.—Catherine Payne, æt. 75, had vertical diplopia of about three years' standing from paralysis of the L. superior rectus with partial ptosis.

I could quote several others to the same point.

Even if paralytic squint be present from birth and persist till the patient be grown up, double vision may still be present, though the conditions call for suppression and amblyopia as imperatively as in the ordinary cases. Thus:—

Case LXVIII.—Mr. K., æt. 23 (P. 14, 16), has paralysis of the L. sixth nerve, which, according to his mother's very circumstantial account, dates from birth or very soon after. He still sees double, and vision in each eye is $\frac{6}{6}$ with and without + 0·5 D., the L. not seeing quite so sharply as the R.

In another instance (Case LXVIII*a*) of congenital paralysis (of R. third nerve), the patient, a boy of 9, though not conscious of ever seeing double sees as well, both at long and short distances, with the squinting eye (after making a little effort), as with the other $\left(\frac{6}{9} \text{ with each}\right)$; 9 years of neglect have caused no true amblyopia. (Master, F., P. 14, 43.)

Again, that an infant with recent paralytic squint does not at once learn to get rid of the false image, is shown apparently by a case in which the baby turned its head exactly as an adult, similarly affected and wishing to get rid of the diplopia, would have done.

Case LXIX.—Lucy Sansums (T. O. P., loose letter), æt. 18 months, with complete paralysis of L. external rectus and convergent strabismus of about two weeks' duration, liked to rotate her head to her left. The condition followed a fit with

unconsciousness three weeks previously. Family history of tuberculosis.

Next, when convergent squint from hypermetropia sets in late, and causes diplopia, there is the same impossibility of acquiring amblyopia, and thus curing the double vision, as in paralytic cases.

Case LXX.—Mr. L., now æt. 40 (P. 5, 138), had no squint till after a "cold" in L. at about 14 years old, for which he wore a shade. Ever since then he has squinted and seen double; the diplopia is constant, but does not trouble him because the images are very far apart. He now has a high, but varying, convergent squint of the L. with some defect of outward rotation and V. $\frac{12}{12}$ partly with $\left\{\begin{matrix}+7 \text{ D.S.} \\ +2{\cdot}5 \text{ D.Cyl.}\end{matrix}\right.$ (The R. has lately failed with central choroiditis; refraction H. 5 or 6 D.)

A similar case is given below (Case LXXVII).

The same statement is true of any other form of concomitant squint, which sets in late, and illustrative cases might easily be given (Mrs. C., P. 13, 194, Mr. F., P. 10, 47).

Even if, in such a case as last mentioned, there be some defect of the squinting eye attributable to anisometropia, this defect does not assist the patient to acquire the habit of suppression (which would nevertheless be an advantage to him) if he possess binocular vision, as in—

Case LXXI.—Master W. R., æt. 15 (P. 12, 38), who has for many years had periodic squint of L., and sees double when he squints. The R. sees $\frac{6}{9}$ with $\left\{\begin{matrix}+1{\cdot}5 \text{ D.S.} \\ +2 \text{ D.Cyl.}\end{matrix}\right.$; the L. $\frac{6}{18}$ with $\left\{\begin{matrix}+4 \text{ D.S.} \\ +1 \text{ D.Cyl.}\end{matrix}\right.$

The prolonged disuse of an eye formerly good (as if a complete cataract be allowed to remain many years without removal, or if after extraction the eye be left for many years without optical correction) does not cause any defect; many years later vision may be quite good. Case

LXIV above illustrates the first statement; the following proves the second:—

Case LXXII.—Robert D., æt. 73 (T. 1, 1884, No. 44). Came to St. Thomas' Hospital on March 3rd, 1883. When æt. 35, L. failed with cataract shortly after an injury to chin and head. He had a "needle operation" by Mr. MacMurdo, but no glass was given and the eye was of no use to him for the next 30 years, during which time he did his work as a fitter with the R. About 7 years before I saw him, the R. failed with cataract, and on now seeking advice at Moorfields he had glasses ordered for the L. (+ 10 D. and + 15 D.) with which he saw "quite well," and was able to continue his work quite satisfactorily until very shortly before admission, when in Feb., 1883, acute glaucoma came on in this (the L.) eye after having been threatened for some months; it did badly after sclerotomy, and was excised. The cataract was extracted from the R. with a good result.

Neither does repeated suppression necessarily lead to any defect at all, even though one eye have to suppress much more often and for longer than its fellow. Thus though in completely alternating squint we should hardly expect the repeated temporary suppressions that of course occur, to produce amblyopia, we should expect this result, at least in some degree, when the squint is almost always, or very often, confined to the same eye. But such is not the case, *e.g.*:—

Case LXXIII.—Mrs. W., æt. 53 (P. 5, 58). Has a slight convergent and upward deviation nearly always affecting the R., but sometimes alternating. Though vision and refraction are exactly alike in each eye $\left\{ \begin{matrix} +2{\cdot}5 \text{ D.S.} \\ -2 \text{ D.Cyl.} \end{matrix} \right.$ R.\L./ giving $\frac{6}{6}$ in each, she always reads with the L. She never has diplopia. No operation was ever done.

Case LXXIV.—Hy. Evans, æt. 21 (M. O. P., loose letter). Has "always had a slight cast in his eyes" but never sees double, and no diplopia can be got with coloured glasses. The L. usually deviates somewhat downwards; its inward movement

is defective, and accompanied by upward deviation and by tremors of the head. The whole L. side of the face is flatter, and the jaw smaller than the R. Vision and refraction exactly alike in the two eyes $\frac{6}{6}$ Hm. = 1·5 D.

Indeed it seems possible to have a constant squint always affecting the same eye with vision almost equally good in the two eyes, and yet never to have diplopia, and never to get any marked defect of visual acuteness, though there must in such persons be constant suppression or neglect of the image in the squinting eye.

Case LXXV.—Miss McW., æt. 8 (P. 13, 189). With constant vertical-lateral squint affecting L. for at least three years, with vision and refraction all but equal in each eye, has no diplopia and none can be obtained by using a prism. R. $\frac{6}{6}$ partly with $\begin{matrix}+2\ \text{D.S.}\\+0{\cdot}5\ \text{D.Cyl.}\end{matrix}$, L. $\frac{6}{9}$ well with $\begin{matrix}+2{\cdot}5\ \text{D.S.}\\+0{\cdot}5\ \text{D.Cyl.}\end{matrix}$

See also Cases XLIX and LXXIX.

Although in such cases there may be little or no lowering of acuteness of vision in the squinting eye as tested by letters, this eye is by no means always, perhaps never, so useful as the other. If each eye be tested separately, the patient will give the preference very clearly to the one which he habitually uses. The squinting eye (or rather its visual centre) seems wanting in endurance and sometimes in rapidity, of perception of print held in the hand, *i.e.*, of a test which requires fine perception, good accommodation, and rapid, small, well-regulated movements of the eye in following the print. The peculiarity is an inability to read correctly for long together with the eye in question; sometimes indeed no effort enables the patient to read the smallest print, even for a little time; and in order to see even for a short time anything like as well as with the other eye, the aid of a disproportionately strong lens is needed. The condition has, without much reason, been called "retinal fatigue." The difficulty is the same for moderately large as for small print, and is certainly not

due in any great degree to difficulty of accommodation. The patient's manner suggests slowness and tiring of perception, or of muscular guidance, for sometimes there is awkwardness in passing from one line of print to the next. Such awkwardness may, however, indicate a (nearly central) defect in the field. The whole phenomenon has been compared to left-handedness, and if the difficulty be muscular the comparison will perhaps hold, on the assumption that the co-ordinating mechanism of the defective eye has never been properly developed, owing to want of reflex stimulus from it, or to some muscular-inadequacy.

Case LXXVI.—Emily Potter, æt. 28 (M. O. P., loose letter). Both internal recti were divided by the late Mr. Wordsworth when she was between 8 and 9 years old, the L. being the squinting eye, and V. $\frac{20}{20}$ (Mr. Wordsworth's notes seen). There is still slight convergent squint of L. when she makes an effort to see well, and though refraction and distant V. are alike (R. $\frac{6}{9}$, Hm. 1 D. $= \frac{6}{6}$; L. $\frac{6}{9}$ Hm. 1 D. $= \frac{6}{6}$) she cannot read 1 J. so well with L. as with R., and the difficulty is not removed either by glasses or eserine to the L.

Case LXXVII.—Miss E., æt. 17 (P. 7, 207). Began to squint with the R. at æt. 7 years; at æt. 11, tenotomy was performed on one eye, and at 14 on the other, and glasses ordered. The result of the operations was to diminish but not to cure the strabismus, and very troublesome permanent diplopia was set up, which has worried her ever since (it is doubtful whether or no she had diplopia before the first operation). Vision and refraction are not equal in the two eyes, but the difference does not explain the much greater difficulty she has in reading small print with the squinting eye.

R. H. (m. and t.) 2·25 D. $= \frac{6}{12}$ well; but even with + 4·5 D. she cannot read small print for long. L. Hm. = 1·5 D., Ht. = 1·75 D. $= \frac{6}{6}$, reads easily.

Case LXXVIII.—Miss S. (P. 3, 1) (now grown up). Had both internal recti divided when she was 7 years old; no note which was the squinting eye. The R. now diverges widely, and inward rotation is very defective in this eye, and less so in L. She thinks she never uses the R., and though she sees $\frac{12}{15}$ as well with it as with the L. she can only see for a moment a few words of 1 J., whilst with the L. she reads 1 J. easily. There is no asthenopia, and the refraction (without atropine) is nearly normal, and almost equal in the two eyes. (R. Hm. ·75 or 1 D. barely: L. Hm. ·75 D.

The following case has been noted in more detail:—

Case LXXIX.—Master K. W., æt. 14 (P. 12, 121), has a slight convergent vertical squint of the R. eye; according to his mother it used to be much more marked. It is thought that the sight of this eye used to be much worse than it is now, but we have no proof of this. When he was about 7 he was made to practise the R. eye separately with a lens, and continued to do so until lately. He was brought to me in Feb., 1886, because on account of some defect of the right he had lately been refused admission to one of the public services.

I found V. of R. to be $\frac{6}{9}$, raised to $\frac{6}{6}$ by + 1·5 D., and V. of L. $\frac{6}{6}$ partly, raised to $\frac{6}{6}$ by 1 + D.; with these lenses he saw $\frac{6}{6}$ equally well with each eye. R. oph. H. 1·5 D. at y.s.; L. H. 1 D. at y.s. Yet for reading ordinary print in the hand, he saw much better with the L. than with the R. Thus with the L. alone, he read print of any size up to 1 J. fluently and continuously; with the R., on the other hand, he could not read any ordinary print fluently for more than about half a minute. With this eye he would read the first line or so of a paragraph pretty well, but on going to the next line he often had difficulty in finding it ("the next line seems to be where the other one was"), and having found it he read the words slowly, and unless they were very short often made mistakes, and had to try two or three times before he got the word correctly.

The difficulty, both as to quickness and accuracy, increased

the longer the attempt was continued, so that after lamely getting through two or three lines, he was obliged to stop after hesitating and mispronouncing various words. (Substituting voice for hand, the difficulty seemed like that of a beginner on the piano who often fails at the first trial to strike a chord which he reads correctly.) When he began he would put the book at a fair distance, but as he went on he brought it nearer and nearer until it almost touched his nose.

I could not get him to describe graphically what his difficulty was with this eye, but his manner of reading was not in the least suggestive of difficulty in accommodation, and accommodation could have had but little to do with it, because convex lenses of various powers up to + 4 D. did not help much.

As it was of great importance that he should if possible get his appointment, we decided that he should again practise the right eye separately with a high convex lens (+ 4 D.). This he did most conscientiously for several weeks; he managed in fact to get through a considerable part of his school-work in this way, with the L. (good) eye excluded. The R. lens was then weakened to + 2 D., and the same process continued for another month or two but without any real benefit, and a year after I first saw him he was still in the same state, passing the distant test equally well with each eye, but showing the same difficulty as before in reading hand type with the R. eye. Trial with a prism and coloured glass showed that he never had binocular vision.

The above facts and considerations show, I think, that neither of the two main theories, amblyopia from suppression, and amblyopia from congenital imperfection, of one eye, has yet been fully established; but that whilst the former view requires proof which has not yet been given, there is much evidence, both direct and indirect, in favour of the latter. We see also that the amblyopia of squinting eyes cannot be properly considered without reference to the function of binocular vision; and that since the latter varies in its perfection, and may even be entirely wanting, though each eye separately sees well, the functional association of the two eyes (visual centres) with each other is, even in man, by no means always so well developed as

we often assume it to be. I suppose that we know too little yet of the development and relative actions of the two sides of the brain to assert that the bilateral centres for functions such as hearing and smell, where central fusion of the sensations from the two peripheral organs is at best very imperfect, are always equally well formed. Should the existence of one-sided congenital imperfection of hearing or smell ever be verified, the discovery would go far to support the theory that the amblyopia of squinting eyes is present at birth, and is not a consequence of the squint.

P.S.—August. I hear that the subject of Case I (p. 353) is in good health, and appears to see much better.

CURATOR'S PATHOLOGICAL REPORT.

By J. B. Lawford.

Cases of Intra-ocular Sarcoma.

Case I (*Reg. No.* 1408).—*Pigmented Sarcoma of Choroid; two recurrences of growth in Lower Eyelid, and subsequently in Orbital Tissues.*

Ethelbert E., æt. 60, labourer, admitted February 3rd, 1884. The sight of the right eye had been failing for two years; he had had no pain till three days previously, when it came on suddenly and severely.

On admission: R. V. = shadows; p. dilated; chemosis; T. + 3, severe pain: L. V. = $\frac{20}{20}$.

February 4th. R. iridectomy upwards. The wound healed very slowly; and pain and increase of tension returning, the eye was removed on March 29th.

Examination of the Eye.—The globe is nearly filled by a fairly solid, irregularly pigmented growth, which springs from the choroid at upper part. Its base extends from close to the optic disc as far as the ciliary body; it soon becomes somewhat narrowed, and then again spreads out into a large rounded tumour, reaching nearly across the eyeball. Anteriorly it presses upon and indents the posterior surface of the lens, making it of hour-glass shape. The retina covering the surface of the growth is softened and degenerate, and covered by a layer of blood clot, which almost fills the small space left to represent the vitreous cavity. The growth has extended through the sclerotic posteriorly, close to the optic nerve.

Microscopic Examination.—The growth is a sarcoma exhibiting very varied characters in its different parts. At the posterior part it is composed of moderate sized round cells, with a fair amount of intercellular material. This part is scantily pigmented. More anteriorly the tumour consists of small spindle cells, grouped together irregularly, giving an appearance as though they were tied up in bundles. Here there is a large

amount of pigment, in round rather large cells. On the inner edge of this part of the tumour, *i.e.*, the edge farthest from sclerotic, is a narrow band of structure similar to the posterior part, and with more pigment; this is much more vascular than any other part of the tumour, containing rather numerous large blood channels. The ciliary body is completely absorbed in new growth at one part. The optic nerve is not invaded. The tumour does not appear to have perforated the choroid at any point. On outer surface of sclerotic, above the optic nerve, is some adherent tissue, containing large numbers of small round cells. This is probably an inflammatory product, and not an extension of the growth. The cells are smaller than any in the growth, and more closely packed.

This patient had always been a strong healthy man. His family history was very good; his mother lived to be 70; his grandmother 98, and his great-grandmother 105.

On November 5, 1884, seven months after the removal of his eye, patient was re-admitted, with a nodule of new growth in the right lower lid, hard and irregular on the surface, as large as a filbert, and adherent to the skin over it. It had been noticed by patient's wife for two months. There were no enlarged glands. This nodule was removed, and on microscopical examination proved to be sarcomatous. The cells were round and rather small, with large nuclei. There was extremely little intercellular material. Numerous vessels in the growth, which was very sparsely pigmented. The deeper layers of skin were involved by the growth.

On January 19th, 1885, the patient returned with a fresh nodule in the outer part of right lower lid. This was removed, and its microscopic characters were found to be very similar to those of the growth removed two months previously, but the component cells were larger, and less closely packed. The pigmentation was no greater.

Five months later (June, 1885) patient returned with a large mass of growth in the right orbit, which nearly filled that cavity; the nostrils and palate were not involved. He was sent to University College Hospital, and had a large tumour removed from the orbit; it had involved the floor of orbit and extended into the antrum. Notes of the case were published in the University College Hospital Registrar's Report for 1885, p. 26.

Some months later he was seen by the Surgical Registrar, who has kindly told me that there was then some recurrence. Since then patient has disappeared.

Case II (*Reg. No.* 1495).—*Melano-sarcoma of Choroid; Invasion of Optic Nerve; death from "Sarcoma" twelve months later.*

Stephen C., æt. 50, relieving officer, admitted July 7th, 1884. The sight of left eye had been failing for 12 months; the eye had been blind for three weeks. Pain came on one week ago.

On admission: R. conjunctival catarrh. L. considerable congestion; slight haze of cornea; pupil wide and fixed; A.C. not very shallow. Yellowish-red reflex from fundus, except on nasal side, where is a large detachment of retina, on which vessels can be made out by focal light. No p.l. T. + 2.

July 8th. L. excised.

Examination of Eyeball.—The anterior parts, *cornea*, *iris*, and *lens*, show no changes. The iris angle is large, and not at all blocked. A large rounded growth occupies the greater part of vitreous chamber. It springs from a broad base at lower and inner part, posteriorly, and extends far forwards, its apex being only 2 mm. from posterior lens capsule. On its surface is a thin layer of blood clot. The *retina* is detached from choroid everywhere, as far forwards as ora serrata. That portion over the growth has almost entirely disappeared. There is a small quantity of blood clot between the healthy choroid and the detached retina on the temporal side. The *choroid* beyond the limits of the tumour is in contact with the sclerotic.

Microscopic Examination.—The tumour consists of an inner part, which is darkly, and an outer part which is moderately, pigmented. The growth is widest at its base, which surrounds the entrance of the optic nerve; its structure in this part shows oval cells, closely aggregated. The pigment is present chiefly in large round cells, which are so black that no structure can be made out. The innermost portion of the growth is much less dense in structure, and consists of round cells. These are not very closely packed. While they are mostly of average size, there are a certain number of much larger circular cells scattered about; each contains a large central nucleus, and in some indications of cleavage of this nucleus are plainly visible.

The pigment in this part, which is moderate in amount, is contained in small elongated or irregularly shaped cells. The growth is not very vascular. The retina on the summit of the tumour has almost entirely disappeared; but elsewhere, though detached, it has undergone little change, except in the bacillary layer, which is scarcely recognisable. The optic nerve is being invaded by a very darkly pigmented portion of the growth, which has extended as far as the lamina cribrosa. Above this, the nerve in section shows hypernucleation, and the central vessels are slightly inflamed. Close to the optic nerve, cells from the tumour are penetrating the sclerotic, along the channel of one of the ciliary arteries.

The family history of this patient was not obtained. On inquiry I learn that he died in July, 1885, one year after the excision of his eye, of "sarcoma," after six months' illness.

Case III (*Reg. No.* 1823).—*Sparsely Pigmented Sarcoma of Choroid; two years later, no Recurrence of Growth.*

Joseph Y., æt. 58, brewer's labourer, admitted on June 5th, 1885, for excision of his right eye. The sight had failed gradually and without pain from August, 1884, and the eye had been quite blind since March, 1885. A severe attack of pain came on five weeks before admission.

On admission: R. eye. Ciliary and general congestion. Cornea steamy; a little blood in A.C. Pupil half wide and motionless. No reflex from fundus. No p.l. T. ? +. L. eye V. $= \frac{20}{20}$.

The sight of the right eye was good till August, 1884, though "it was never so strong as the left eye." No injury at any time.

Examination of Right Eye.—Cornea to naked eye normal. A.C. of good depth in centre, and filled by soft jelly-like effusion; the iris and cornea are adherent at the periphery. *Iris* adherent to lens capsule at pupillary edge. *Lens in situ;* nuclear opacity. *Retina:* infundibular detachment. Much soft subretinal effusion, with a small quantity of blood clot. Just above optic disc is a new growth, the size of a large pea, springing from choroid and projecting forwards. Its base is comparatively

narrow, but it soon spreads out into a rounded top, reaching as far as the equator of the eye. On its anterior surface is a small quantity of blood clot.

Microscopic Examination.—The tumour, which is a sarcoma, consists in greater part of small round cells, with very little supporting tissue. At its base, however, the cells are elongated, and some are spindle-shaped. In this, the oldest part of the growth, there is a moderate amount of pigment, but in the anterior portion there is an almost complete absence of it. The optic nerve and sclerotic are not invaded by the growth. The detached retina shows some signs of degeneration, the nerve fibre and ganglion-cell layers are slightly œdematous.

This patient was a weakly thin man, who had suffered from chronic bronchitis, and had for some years been thereby incapacitated for work.

June, 1887. Patient is alive, and as well as he was at time of operation, now two years ago. There is no sign of recurrence of the growth.

Case IV (*Reg. No.* 1863).—*Sarcoma of Ciliary Body arising in an Eye Blind from Injury 25 years previously; Advanced Mucoid Degeneration of the Tumour.*

Ann S., æt. 63, admitted July 9, 1885. Twenty-five years ago had a severe blow on her left eye by a fist, and two years subsequently she found suddenly that the eye was blind. It gave no trouble till nine weeks before admission, when "inflammation set in," with severe pain which has continued on and off since.

On admission: R. $\frac{20}{20}$. L. slight congestion; shallow A.C.; P. inactive; posterior synechiæ; lens opaque. No p.l., T. +2.

July 10. L. eye excised.

Examination of Left Eye.—*Cornea* normal. A.C. very shallow, filled by soft coagulated effusion. The iris angle is blocked by adhesion of iris and cornea; a thin membrane occupies the pupil. There are numerous posterior synechiæ. *Lens in situ;* nuclear opacity. *Vitreous* clear. *Retina* and *choroid in situ. Optic papilla* normal in appearance. In upper part of vitreous, anteriorly, is a pyriform, yellowish growth measuring 8 mm. in

its greatest diameter, attached to ciliary region; its outline anteriorly follows that of the posterior surface of the lens with which it is in contact.

Microscopic Appearances.—The growth springs by a narrow base from the ciliary processes, and extends towards interior of eye. It completely replaces the ciliary processes, and is beginning to invade the ciliary muscle; it also extends into the root of the iris. The pars ciliaris retinæ can here and there be traced on its surface, but generally it has disappeared. The growth is near its root very vascular, containing a number of large vessels. It is here very densely pigmented, but in its central part the pigment is much less abundant. The whole growth has undergone advanced mucoid degeneration, only small portions remaining to show its original structure. In such parts the cells are small, and oval in shape. The pigmented cells have not been affected by this degeneration, and stand out very prominently in the homogeneous tissue. Some of the vessels in the tumour are greatly changed—their walls very thick, and hyaline in appearance, with a few small faintly staining nuclei, and their lumen almost obliterated. The iris is atrophied and adherent to lens capsule at the pupillary edge. The lens fibres are degenerated in the part adjoining the tumour. At anterior pole is a layer of new nucleated tissue immediately beneath the capsule. The choroid and retina show no changes.

June, 1887. Patient is now (23 months after operation) quite well. There has been no recurrence of the growth.

Case V (*Reg. No.* 1885).—*Irregularly Pigmented Sarcoma of Choroid.*

Eliza A., æt. 33, single, cook, admitted June 7, 1885. She had been an out-patient in October, 1884, when detachment of retina on temporal side of right eye was found. The sight of

right eye was then $\frac{20}{70}$. It became progressively worse till, in April 1885, patient could not count fingers correctly. The detachment of retina had increased in size. There had been no pain.

On admission: R. cornea hazy; A.C. shallow; No p.l. T. + 1. No fundus reflex. L. V. $= \frac{20}{20}$.

June 8th. R. excised.

Examination of the Eye after Removal.—At upper outer part there is a smooth, rather conical bulging of sclerotic, chiefly in the area between the tendons of the superior and external recti. Over this bulging part there is some inflammatory thickening. *Cornea* thin. *Iris* is in contact with posterior surface of cornea in whole extent, pressed forwards by the lens which is close behind it. The *lens* is opaque in central part. Immediately behind it is the folded detached retina, which stretches forwards from O.D. in a round cord, and its anterior part is closely in contact with the lens. The subretinal space is filled by a tenacious jelly-like material.

In the upper outer part of the globe, behind the equator and between that and the optic disc, is a dark firm growth as large as a pea, arising from the deep layers of the choroid and projecting into the subretinal space. Springing from a very wide base, it soon becomes narrowed, and then again expands. The hexagonal epithelial pigment can be traced over the surface of the growth. Immediately below the tumour is a solitary patch of atrophy of choroid, but everywhere else this tunic appears normal. The sclerotic and optic nerve are not invaded by the growth.

Microscopical Appearances.—The growth is composed chiefly of small round and oval cells, but in some parts there are numerous spindles; and scattered through the growth a few very large circular cells, which are usually quite solitary, and contain one central nucleus. Some parts of the growth are almost devoid of pigment; others are nearly black with it. The pigment is largely contained in circular cells, similar in size and other appearances to the large cells above mentioned, but they are so darkly pigmented that it is impossible to distinguish a nucleus. Other cells containing pigment are smaller and less regular in outline. The growth is extremely

vascular, especially in its inner portion, where there are numerous vessels. Some of these appear to be mere channels in the new growth; but in most a definite wall can be seen, composed of one or two layers of flattened epithelioid cells with long nuclei. A few hæmorrhages are also met with. The growth is covered by the elastic lamina of the choroid, and the hexagonal epithelium is scarcely at all displaced. The sclerotic shows no signs of invasion by the sarcoma cells.

June, 1887. Patient writes, in reply to inquiries, that she is in good health.

Case VI (*Reg. No.* 1994).—*Melanotic Sarcoma of Choroid; Commencing Infiltration of Sclerotic by Cells of the Tumour.*

Thomas B., æt. 64, chimney-sweep, admitted January 5, 1886.

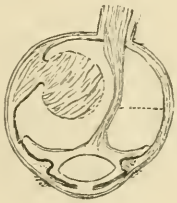
The sight of right eye had been failing for two months. No pain till 10 days ago.

On admission: R. cornea and iris dull; p. dilated; media hazy; T. + 2; V. = bare p.l.

January 5. R., iridectomy upwards.

January 15. R. excised.

Examination after Removal.—The iridectomy incision has reopened during excision of the eye. *Cornea* is thickened close to the cut edges. *Iris* against posterior surface of cornea; A.C. is thus obliterated. A portion of iris at upper part wanting. *Lens* clear. *Retina* detached everywhere, from O.D. to ora serrata. It forms a narrow rounded stalk which passes forwards from optic nerve entrance to the back of the lens. On temporal side of eyeball is a deeply pigmented, vascular growth which projects rather more than half way across the vitreous cavity. It has a broad base, above which is a very narrow neck, and then a globular top, which pushes the detached retina a



short distance towards the nasal side. In other parts the choroid shows no changes.

Microscopic Examination.—Growth is a round-celled sarcoma springing from the deeper layers of the choroid. The elastic lamina can be traced on the surface of the growth from the base, over the neck and along the under surface of the rounded body, but is absent from the summit where the tumour appears to have perforated the choroid.

The pigment in the tumour is irregular in distribution, some portions being almost devoid of colour, other parts almost black. Large vascular channels can be seen in the growth. The sarcoma cells are beginning to infiltrate the sclerotic, passing in along a large vessel which perforates this tunic.

June, 1887. Patient reports himself as quite well.

CASE VII (*Reg. No.* 1999).—*Unpigmented Round-celled Sarcoma of Choroid.*

Edridge P., æt. 64, farmer, admitted January 26, 1886. In August, 1885, he noticed "a cloud" over the sight of his left eye, and this gradually increased in density. In October, 1885, he attended as an out-patient, and his sight was then: R. $+ 2$ D. $\frac{6}{12} + 6$ D. $= 1$ J. L. $+ 4$ D. $\frac{6}{18} + 8$ D. $= 1$ J., barely.

On January 26, 1886, the condition was: R. $\frac{6}{24} + 2{\cdot}5$ D. $\frac{6}{9}$; $+ 6$ D. $= 1$ J.; T.n.; pupil active. L. less than $\frac{6}{60}$; fingers at 6″. T.n. A.C. shallow. *Oph.:* Large, deep detachment of retina at lower part, with appearance of something red and solid beneath it; ? tumour.

January 27, 1886. L. excised.

Examination after Removal.—The eyeball is of normal shape and size; there is no bulging of sclerotic at any part. Anterior perforating arteries are enlarged on temporal side. *Cornea* healthy. A.C. obliterated at periphery by contact of iris and cornea; central part shallow. *Lens in situ* and clear. Some posterior synechiæ. *Retina*: extensive detachment. On temporal side it is widely separated from choroid from the O.D. to the begin-

ning of the ciliary part. On nasal side is a very shallow, and less extensive detachment. On outer side and lower part of eyeball is a rather large rounded tumour, between choroid and sclerotic, the former tissue being pushed inwards. This growth extends from the vertical mid-line of the eye below, outwards over a quarter of the circumference, and its posterior border is 10 mm. from the O.D.; anteriorly it just overreaches the posterior ends of the ciliary processes, which it displaces slightly inwards. Its surface is smooth and covered by choroid, except at one point near its posterior edge where a small nodule has perforated this tissue, and lies between the choroid and the retina. On section (fresh) the cut surface becomes markedly convex; the mass is very soft to the touch, and is nearly white, being apparently quite devoid of pigment. The choroid elsewhere is healthy.

Microscopic Examination.—The tumour is a round-celled sarcoma. The component cells are small and closely packed; a few delicate fibrous bands run through the growth and divide it into imperfect lobules. A thin layer of choroid remains at outer surface (next the sclerotic) of growth, and the elastic lamina of the choroid covers the inner surface except over the nodule mentioned above. The growth is quite free from pigment. Its cells are beginning to infiltrate the sclerotic at one point; anteriorly it is growing in between the sclera and the ciliary muscle, and displaces the latter inwards, but there is no infiltration of the muscle by the cells of the tumour. The growth is moderately vascular; no hæmorrhage discovered in its substance.

This patient, a robust man, with sallow complexion, gave the following family history:—He is one of six, of whom three are living; one sister died of "cancer of the womb," æt. 52; one sister died of "consumption," æt. 20. His father died of "cancer of the stomach," æt. 67. His mother died of "paralysis," the cause of which was unknown, æt. 75.

June, 1887. Patient writes that he is now in good health.

Case VIII (*Reg. No.* 2010).—*Partially Pigmented Sarcoma of Choroid; Invasion of Sclerotic by the Growth.*

Robert A. T., æt. 60, police inspector, admitted 10th February, 1886, and right eye removed the next day. Patient had only made complaint of this eye fourteen days before admission, but

when questioned he said he thought there was "something wrong with it" six months before. The sight has failed very rapidly in the last few days.

On admission: R. counts figures at 6"; pupil active. T.n. *Oph.*: Detachment of retina over inner half. L. $\frac{6}{36}$, lenticular opacity.

Examination of Eyeball.—No bulging or evident thinning of sclerotic. *Cornea* clear. *A.C.* rather shallow. *Iris* normal. No adhesion to cornea at periphery. *Lens* clear, not displaced. A large rounded growth arising from upper and outer part anteriorly, projects into and fills about one-third of the vitreous cavity. Its posterior border is 6 mm. from O.D., and the width of the base of growth is 11·5 mm., its greatest measurement from base to summit 9 mm. Its surface is smooth and everywhere covered by the inner layers of choroid and the pigmented epithelium. The cut surface of the tumour exhibits some difference in colour, the posterior and upper one-third being very slightly pigmented, the remaining two-thirds containing a considerable amount of dark-brown pigment. The choroid beyond the limits of the growth is apparently normal. The retina is closely applied to the surface of the growth, and is everywhere else in contact with the choroid; thus there is really no detachment of retina from choroid, as the tumour is still beneath the inner layers of this coat. Optic papilla normal.

Microscopic Examination.—The tumour is composed of mixed small spindle and round cells. Its innermost part is extremely vascular, containing numerous vessels of varying size, many of them large with well-formed walls. The pigment in the darkest part is evenly distributed through the growth, and is mostly contained in fair-sized cells, like the stellate pigmented cells of the healthy choroid. There is no implication of the optic nerve by the growth; the sclerotic, however, is being infiltrated by the sarcoma cells. The lamina elastica and the hexagonal pigment layer pass over the surface of the growth unaltered.

In this case there was no family history of malignant disease in any form. There was an indefinite history of a blow on the eye by a cricket bail many years previously.

The patient was a strongly built, healthy-looking man, who suffered from occasional attacks of gout.

Up to present date, July, 1887, he has kept perfectly well, and there are no signs of new growth in the orbit or elsewhere.

Case IX (*Reg. No.* 2036).—*Small-celled partially pigmented Sarcoma of the Choroid; invasion of Optic Nerve and Sclerotic; 15 months after removal of eye, symptoms pointing to occurrence of secondary growth in Bones of Skull or Cerebral Meninges.*

Julia J., æt. 44, widow, admitted March 17th, 1886, for excision of left eye. In September, 1884, she had attended as an out-patient complaining of failure of sight in the left eye. Her vision was then R. -7 D. $\frac{20}{40}$. L $< \frac{20}{200}$, 16 J.

In October, 1885, a note on the O.P. letter is—"L. much worse; V. = shadows only; large detachment of retina." Soon after this the left eye became quite blind, and in March, 1886, shortly before admission, severe pain came on, with increase of tension and chemosis of conjunctiva.

Examination of Eye after Removal.—Cornea, some loss of transparency, otherwise normal. *A.C.* normal. *Iris* thin; several posterior synechiæ; no adhesion to periphery of cornea; small extravasations of blood on anterior surface. *Lens* clear, *in situ*. *Retina* contains very numerous small hæmorrhages. It is extensively detached by a new growth, which springs from choroid above and to outer side of optic disc. This tumour is softish, of a grey colour in greater part. Arising from a moderately broad base, it then narrows to form a small neck, and subsequently expands into a globular shape, extending far forwards in the vitreous cavity on outer (temporal) side, pushing the retina in front of it. It is apparently covered by the inner layers of the choroid in its whole extent. In its anterior and inner part is a small cavity containing a little blood clot. At that part of its base nearest the O.N. the growth is darkly pigmented; elsewhere it appears almost free from pigment. The O.N. is invaded by the pigmented portion for a short distance from the disc, but the nerve has been divided behind the posterior limit of this extension of the tumour. The *choroid* beyond the limits of the growth is intensely congested, but otherwise appears normal. The *sclerotic* to the naked eye shows no signs of invasion by the growth.

Microscopical Appearances.—These differ considerably in different parts of the tumour. The most posterior part and the portion next the sclerotic consists of moderate sized round cells with a very small amount of stroma. The inner and anterior parts, however, show cells of various shapes, and they are arranged in groups and columns in a somewhat unusual way, in some places giving a section of the growth, very much the appearance of gland structure with acini. These columns are two cells in width, the cells being pear-shaped with large nuclei, and with their small ends inwards fitting in one above the other, and their broad ends outwards. The columns appear to be separated from each other by very delicate strands of connective tissue, with long thin nuclei like those of unstriated muscle fibres. Some of these columns or tubular collections of cells form almost complete circles. This part of the tumour is entirely devoid of pigment, but a small part near the O.D. where the cells are round contains a considerable quantity of pigment in rather large circular or irregular-shaped cells. The growth is nowhere very vascular, but there are several small extravasations of blood in its substance. The inner layers of the sclerotic are being invaded by the sarcoma cells.

This patient, who was a dark complexioned woman, looking much more than her age, had no family history of tumour; and had had no injury to the affected eye.

She came up to the Hospital by request, June 14th, 1887, and Mr. E. T. Collins, the Senior House Surgeon, kindly gave me the following notes which he made:—"Since leaving the Hospital in March, 1886, she has had constant pain on top of her head and across temples; the scalp is very tender, so that she cannot comb her hair. Has had no "fits," but at the beginning of the present year (1887) she "lost her senses" for a fortnight, and was confined to bed for three months. The doctor in attendance said she had "congestion of the brain." There is no sign of recurrence of growth in the orbit.

CASE X (*Reg. No.* 2067).—*Round-celled Sparsely Pigmented Sarcoma of Choroid; Invasion of Sclerotic.*

Josiah N., æt. 59, dock wharfinger, admitted May 6th, 1886, and left eye excised the same day. In February, 1885, he had attended

as an out-patient, complaining of failure of sight for the previous 12 months. At that time R. V. $= \frac{20}{0} + 3$ D. 16 J. L. V. $= \frac{20}{50} + 3$ D. $= 4$ J. Slight haze of lenses. Deep physiological cupping of optic discs. The sight of both eyes got gradually worse, and he did not notice that the failure was greater in the left than in the right, till on May 3rd, four days before admission, when severe pain came on suddenly in the left eye and brow, and the sight of that eye was soon completely lost. On admission there was no p.l. in left eye; T. + 2; œdema of lids and conjunctiva.

Examination of Eye.—Conjunctiva at corneal margins swollen and œdematous; anterior *corneal epithelium* slightly rough on surface, and hazy. In lower half of anterior chamber is a dark blood clot. On opening the eyeball a large quantity of dark semifluid blood escaped, and with it the shrunken remains of the vitreous, the anterior part of retina, and the lens. The posterior portion of *retina*, which was separated everywhere from choroid, remained attached at optic disc; it was much softened and degenerated. Growing from the choroid at upper and outer part is a soft reddish tumour. The base is fairly wide, and its posterior limit is 14 mm. from the outer edge of O.D. Anteriorly it extends forwards nearly to the root of the iris, and displaces the ciliary body inwards. It projects just halfway across the eyeball. In its substance is some hæmorrhage, and near its anterior border several small cysts. It is apparently very slightly pigmented. Beyond the limits of the tumour the choroid appears normal.

Microscopic Appearances.—The growth is composed of well-formed round cells, with large nuclei. Except at one part close to its posterior border, it is free from pigment, but here there is a large amount of dark pigment contained in round cells, equal in size to those of the growth. The anterior part extends between sclerotic and choroid as far as the origin of the ciliary muscle, which is pushed inwards by it, but shows no infiltration by the sarcoma cells. The inner layers of the sclerotic, however, are infiltrated. The inner layers of the choroid cover the tumour everywhere. In the substance of the growth is much blood extravasation.

June, 1887. Up to this date, 13 months after the removal of the eye, there has been no recurrence and no symptoms of metastatic growths.

Case XI (*Reg. No.* 2086).—*Diffuse Sarcoma of Choroid, with Mixed Round, Oval, and Spindle Cells; Optic Nerve not involved.*

Matilda E., æt. 35, monthly nurse, admitted June 7th, 1886, and underwent excision of left eye the next day.

For the preceding twelve months she had had frequent short attacks of dimness of sight in left eye, lasting only a few minutes. Eight weeks before admission pain began in left eye, and left side of face and head, with swelling of eyelids. She then found that the eye was blind, but it is uncertain how long it had been in this condition. No history of injury.

On admission: L. The conjunctiva is protruding between the eyelids, and is greatly congested and thickened. Aqueous turbid, and iris much discoloured. No p.l. T.n. R. V. = $\frac{20}{30}$.

Examination of Eye.—The eyeball was frozen and divided antero-posteriorly into two lateral halves. A.C. full of light-coloured coagulum containing a considerable amount of blood, which extends behind iris and round the margin of lens on to ciliary processes. *Cornea* is somewhat increased in thickness. *Iris* very narrow, not adherent to cornea or lens capsule. *Lens in situ;* cortical layers opaque. *Retina*, umbrella detachment; in its folds are some shreddy remains of vitreous. The sub-retinal space is filled by soft greyish jelly-like effusion, and at lower part between this and the choroid is a dark blood clot. At posterior pole of eye and surrounding the optic nerve entrance is an area of thickening of choroid, which on temporal side reaches to a point just in front of equator, but on nasal side only about half that distance. It has a thickness of 1·5 to 2 mm., close to O.D., and gradually thins off; it is grey in colour and firm. Its true nature was not suspected from naked eye examination.

Microscopical Appearances.—Sections of the "thickened choroid" prove it to be a diffuse sarcomatous growth, consisting chiefly of oval and spindle-shaped cells, with some round cells at the growing edges. It shows no tendency to grow forwards, but is spreading circumferentially, and is invading the innermost layers of the sclerotic. The optic nerve is not involved, and the choroid has not been perforated anteriorly by the growth.

There is but a small amount of pigment in the tumour, not relatively more than in the choroid in portions not yet attacked.

June, 1887. There has been no recurrence of growth up to this date. Patient considers herself "very weak," but there are no symptoms of organic disease.

CASE XII (*Reg. No.* 2133).—*Melanotic Spindle-celled Sarcoma of Choroid.*

Henry T., æt. 63, butcher, admitted August 10th, 1886. The sight of the left eye failed four months previously "on outer side." Quite blind for two months, and painful for one week past.

On admission: L. No p.l. T. + 1. P. dilated.

August 11. L. excised and examined at once.

Cornea, *iris*, and *lens* apparently normal. No blocking of iris angle. *Retina* detached everywhere, from O.D. to ora serrata. A large deeply pigmented growth springs from choroid at nasal side, and projects half way across the eyeball. Its posterior limit is 2 mm. from inner margin of O.D.; its anterior almost reaches to ora serrata. It is firm to the touch, dark slate colour, and has not perforated the elastic lamina of the choroid.

Microscopic Examination.—The growth is a spindle-celled sarcoma, containing a large amount of pigment. It does not invade the optic nerve or sclerotic.

July, 1887. Patient is in good health, and has had no symptoms of recurrent growth.

CASE XIII (*Reg. No.* 2136).—*Small-celled Melanotic Sarcoma of Choroid, arising in a previously injured Eye.*

Francis Henry B., æt. 42, warehouseman. Admitted August 13, 1886. On August 4 he attended as an out-patient, and the following notes were made:—Blow on right eye seven or eight years ago by a small weight on the end of a string. Defect of R. (metamorphopsia and micropsia) two and a half years, and since then it has diverged. Never painful. Now V. = fingers at 3 feet in temporal part of field. T.n. *Oph:* Deep detachment of retina everywhere except over a narrow sector inwards. L. $\frac{6}{6}$ and 1 J.

August 14. R. excised.

Examination of Eye.—Anterior parts, *cornea, iris,* and *lens* normal. *Retina*, detached, except at O.D. At posterior pole, a little above and to outer side of O.D., is a rounded smooth growth, the size of a large pea, projecting forwards. It is dark brown in colour, and firm in consistence, and is covered anteriorly by the inner layers of the choroid.

Microscopic Examination.—This proves to be a small-celled sarcoma, the cells being round and oval in shape, but all of small size, and with a considerable amount of homogeneous intercellular material. It is very deeply pigmented, containing large numbers of pigmented cells of varying size, many of them larger than the unpigmented ones. A small amount of pigment is visible in some places, free in the intercellular material, in very small granules, and here it appears to be of a lighter colour than that which is intracellular. The growth has not perforated the elastic lamina of the choroid, nor invaded the sclerotic or optic nerve.

June, 1887. The patient is now in good health, and has had no symptoms of recurrence of the growth.

CASE XIV (*Reg. No.* 2203).—*Partially Pigmented Sarcoma of Choroid; Extension into Optic Nerve; New Growth in an Eye Blind from other Causes.*

Kate G., æt. 35, single, nurse. Admitted November 25, 1886. The sight of her right eye has been failing for four or five years. Between two and three years ago she received a very severe blow on right forehead by a window blind; the forehead was cut, and bled profusely, but there is no evidence that the eyeball was struck. Eighteen months ago she attended at another hospital, and was then quite blind (no p.l.) in right eye, and had severe pain. She was treated by iodide of potash, and used atropine locally, and in four months the pain disappeared. Since then she has had several short attacks of acute pain in the right eye.

On admission: R. p. dilated; lens opaque. No p.l. T. + 2. L. $\frac{20}{20}$. 1 J. T.n.

November 26, 1887. R. excised.

Examination of Eyeball after Removal.—*Cornea* thin, but not misshapen. *A.C.* shallow, and filled by a soft grey semi-transparent coagulum. It is encroached upon by the adhesion of iris and cornea at their periphery. *Iris* and *ciliary processes* considerably atrophied. *Lens in situ*, opaque, but not shrunken. *Retina* detached everywhere between O.D. and ora serrata. Occupying the subretinal space on the temporal side is a rounded mass of new growth, with a slightly nodulated surface, which is everywhere covered by the choroid. It has a wide base, reaching from close to the O.D. to a point 5 mm. posterior to ora serrata. The cut surface is greyish in colour, and in parts darkly pigmented. The anterior end of the optic nerve shows signs of invasion by the growth. The choroid elsewhere is in contact with sclera; on its inner surface is a small amount of blood clot.

Microscopic Characters.—The tumour is a mixed round and oval cell sarcoma. The outer part, near the sclerotic, is almost devoid of pigment except just at its margins, but the inner part near its choroidal cover contains a large amount of pigment, much of which is in large, very dark cells, but some of which consist of granules of colouring matter, free in the intercellular material. The growth is not very vascular, but shows in sections a few very large vascular channels, lined with a single layer of flat cells, each with a single nucleus. These vessels are generally full of blood.

There is no invasion of sclerotic, but the cells of the growth are infiltrating the optic nerve at the disc.

This patient had a perfectly good family history, and had herself always been healthy. At present date, July, 1887, she is quite well, and has had no sign of recurrent growth.

CASE XV (*Reg. No.* 2248).—*Sarcoma arising in a Shrunken Eyeball; Sympathetic Ophthalmitis in its Fellow.*

James W., æt. 40, carpenter, was admitted on February 4, 1887, and his left eye excised the same day. He had been an out-patient at the hospital in May, 1880, and the notes then made are, L. iritis, hæmorrhage in vitreous. No known cause.

August, 1880. R. $\frac{20}{20}$, 1 J. L. no p.l., T—. Eye very painful. Excision recommended.

He was not seen again till February 1, 1887. He has had several attacks of "pain and inflammation" in the L. eye since 1880, each attack lasting about a week, and being sufficiently severe to keep him away from work. The last attack was in October, 1886. Three weeks ago (during another attack in left eye) the sight of right eye became dim, and pain and congestion came on.

On admission: R. sympathetic iritis, V. = 16 J. T.n. L. shrunken and squared.

Examination of Left Eye after Removal.—Eyeball considerably shrunken and misshapen, measuring only 15 mm. in its antero-posterior diameter, and slightly more transversely. The cornea is shrunken to a narrow triangular area, it is flat and nearly opaque throughout.

All the structures in the eyeball are much altered. The iris is scarcely distinguishable by the naked eye, but the ciliary processes can still be made out: they are detached and drawn inwards towards centre of eyeball. Some dense fibrous tissue in anterior part of eyeball. *Lens* shrunken and calcareous. *Retina* unrecognisable.

At posterior part is a rounded mass of new growth, which nearly fills the eyeball, reaching forwards close to the lens. Traces of *choroid* can be seen on the anterior surface of this mass, and on inner surface of sclerotic over rest of eyeball.

Microscopically.—The new growth is a sarcoma, consisting of round and oval cells with a moderate amount of intercellular material, and springs from the choroid posteriorly. It apparently does not invade the optic nerve, but covers over the disc, and the retina has entirely disappeared. It has extended through the sclerotic on temporal side of, and close to, the optic nerve, and a small nodule of growth has formed here. The growth is not very vascular, only a few blood-vessels running through it. It is devoid of pigment, except where covered by the choroid. There is well-marked inflammation of the iris and ciliary processes, and in the former are islands of small cells, "iritis maligna." The choroid can be traced over part of the tumour, and shows colloid outgrowths from it with small accumulations of pigment about them. The cornea is much degenerated, and Descemet's membrane separated from it in places and corrugated. As far as can be ascertained there is no recent perforation of the

anterior parts of the eyeball, a careful examination for such having been made.

This patient has returned to the hospital since the excision of his left eye; the disease in the right eye has run a slow, but disastrous course, and vision has been reduced to counting fingers. There has been no sign of recurrent growth in the right orbit.

Case XVI (*Reg. No.* 2254).—*Sarcoma arising in an Eye blind for 17 years. Extension of Growth through the Sclerotic Coat.*

Henry R. D., æt. 47, agent, admitted February 7, 1887. Eighteen years previously he was under the care of a London surgeon for "detached retina" in his right eye. He then had no pain, but six months later "acute glaucoma" supervened, and the sight was lost. The eye subsequently shrank. For the last 16 years he has had frequent attacks of "inflammation" in the right eye, with severe pain. He has worn a glass eye over the shrunken one. During the last 12 months the attacks of "inflammation" have been very frequent. Six weeks ago he noticed a "swelling on the eye" which has increased very rapidly, without much pain.

On admission the following notes were made: R. shrunken globe, conjunctival injection. At outer side of cornea is a hard, dark, prominent mass the size of a small nut, over which the cornea and conjunctiva appear to be stretched. L. $\frac{20}{20}$ partly.

February 8. R. eye excised.

Examination of Eyeball.—It is much shrunken and misshapen. The cornea is yellowish and opaque, and very vascular, and prominent. The sclerotic somewhat puckered and irregular. On dividing the eye antero-posteriorly it is found to be completely filled by a reddish-grey soft growth, which shows an imperfectly lobulated arrangement, and has in some parts a gelatinous appearance. This growth has not perforated the cornea, though it reaches to its posterior surface; it has, however, made its way through the ciliary part of the sclerotic on one side, but appears to be covered by conjunctiva even at this point. There is no recognisable retina or choroid, and no trace of lens can be seen, the eyeball consisting simply of a mass of

new growth enclosed by the sclerotic and cornea. The optic nerve at the O.D. appears to be involved in the growth.

Microscopic Examination.—The new growth is a mixed round and spindle-celled sarcoma. It is impossible to tell at what part it has originated, as it has now completely filled the eyeball, and no traces of the normal structures can be made out.

In the peripheral part the cells are small, either round or oat-shaped, and closely packed, with scarcely any appreciable intercellular material; but in the central part the texture of the growth is much looser, and the cells are round or polygonal from pressure, and are arranged in little groups or columns, and here and there a somewhat alveolar arrangement is evident. In several places it is easy to see the division of nuclei taking place in the cells. There is no general pigmentation of the growth, but there are isolated patches of very dark pigment to be seen. There are numerous small recent extravasations in the growth, and the islands of pigment just mentioned may be the remains of former extravasations. Though many of these hæmorrhages are visible, there are very few blood-vessels to be seen.

The only evident perforation of the sclerotic by the new growth is that mentioned above, but the inner layers of the sclerotic are almost everywhere becoming infiltrated by the sarcoma cells. The anterior extremity of the optic nerve is also being invaded by the growth.

June, 1887. This patient is now quite well.

Case XVII (*Reg. No.* 2255).—*Round and Oval-celled Sarcoma of Choroid, originating in a previously Blind Eye (?); Extension of Growth to Optic Nerve and Retina, and into Episcleral Tissues.*

Charles M., æt. 47, engineer. Admitted February 7, 1887. His left eye had been wounded by a fragment from the "gauge glass" of an engine, in June 1882. In the following September he found that eye was nearly blind. In February, 1883, the eye was acutely inflamed and the sight then completely disappeared. It gave him no further trouble till November, 1886, when it was again inflamed, and severe pain came on.

On admission: R. $\frac{20}{20}$. L. cornea steamy, p. dilated and inactive. Some blood on surface of iris. Dull reflex from fundus. No p.l. T. + 3.

February 8. L. excised.

Cornea normal. No scar discoverable in cornea or sclerotic. *Iris* adherent to cornea at periphery. *Lens in situ*. *Vitreous* slightly shrunken. *Retina* is in contact with choroid generally, but separated from it over a limited area at posterior pole. On temporal side of O.D. is a new growth, the size of a small pea, projecting forwards and overlapping the disc, so as to entirely hide it. It has a circular outline and is smooth on the surface, and covered almost entirely by the choroid which it pushes in front of it. The retina is adherent to it towards its nasal side, not elsewhere, though its detachment is of very slightly greater extent than the size of the tumour. The choroid is thickened considerably over a circular area round the growth. The cut surface of the growth shows it to be irregularly pigmented.

On the external surface of the sclerotic, over the part between the O.N. and the tendon of the inferior oblique, is a hard nodule of new growth, very firmly attached to the sclera. There are traces of the tumour in the optic nerve, close to the disc, but the nerve has been cut well behind this part. The nodule on the sclera has also been fully removed, *i.e.*, it shows no cut surface. This part on section is lighter in colour than the intra-ocular part and looks unpigmented. It is not encapsuled.

Microscopic Appearances.—Sections through both nodules of growth and optic nerve show that all the structures at posterior pole of eye are involved. The tumour has perforated the choroid anteriorly and infiltrated the overlying retina at that part at which it remains adherent to the growth. It has also passed into the nerve sheath through the optic aperture, and is spreading backwards in the sheath space; the nerve itself is implicated in its anterior extremity. The choroid for some distance round the tumour is infiltrated and considerably thickened by its cells, which have also extended through the sclerotic and formed the extra-ocular nodule, these two portions of growth being thus directly continuous one with the other. The component cells are round and oval in shape; there are no spindles. While the greater part is unpigmented, there are

here and there in the intra-ocular part islands of pigment, the colouring matter being contained in large round cells and a few multipolar cells. The pigmentation seems to have a definite relation to the blood supply, and is only evident in the neighbourhood of large vascular channels. Of these there are a goodly number, of large size, some with distinct but very thin walls, others apparently mere channels in the substance of the growth.

July, 1887. There has up to this date been no sign of recurrent growth in the orbit, and the patient is in perfect health. A sister of patient, when æt. 30, had one breast removed for "tumour." This was seven years ago, and there has been no recurrence. There is no other family history of importance.

Case XVIII (*Reg. No.* 2257).—*Melano-sarcoma of Choroid and Ciliary Body: Invasion of Lens by the Cells of the Tumour.*

William G., æt. 49, labourer, admitted February 9th, 1887. Seven or eight years ago patient discovered that he could not see to read with his left eye, but is not aware how long the eye had been defective. He noticed no difference till three weeks ago, when he found the sight of this eye failing very rapidly, and during the last three weeks he has had some pain in it. He had never had the eye injured.

On admission: R. V. $= \frac{6}{6}$; pupil and T. normal. L. Counts fingers at 2 feet. There is some thinning and bulging of sclerotic in ciliary region on temporal side. A.C. shallow, P. oval; iris bulged forward on nasal side. T.n.

Oph.—A large brown mass seen close behind lens on temporal side, rounded in outline and covered by retina.

February 10. L. excised.

Examination after Removal.—Cornea normal. *A.C.* obliterated in nasal half, by contact of iris and cornea. They are not adherent however. The *lens* is displaced slightly inwards and forwards, where it presses on the iris and ciliary body. It is clear in greater part. Some uveal pigment on its anterior capsule. *Vitreous* clear and of normal consistence. On the temporal side of the eyeball anteriorly and projecting into vitreous cavity is a large new growth, which extends backwards

from sclero-corneal junction a distance of 11·5 mm., measured across the base of the arc of sclera. It has a rounded surface and reaches nearly half way across eyeball, its greatest depth being 10·5 mm. Its anterior surface is in contact with the outer half of posterior surface of lens, and the lens is here flattened by the growth, as well as being displaced. The ciliary body at this part has disappeared in the new growth, and the root of the iris is involved, a small black nodule having reached the anterior surface of the iris close to its peripheral attachment. The tumour has retina and choroid on its surface, and the detachment of retina is limited to the portion beneath which the growth is situated. On section, the outer part near the sclerotic is deeply, and the inner half slightly pigmented. The choroid and retina beyond the limits of the tumour appear normal. The optic papilla on section is not swollen.

Microscopic Appearances.—The growth is a sarcoma containing round, oval, and spindle-shaped cells, and varies considerably in appearance in different parts. The cells are generally closely packed, especially in those areas in which they are or should be round, for they are frequently somewhat altered in shape by mutual pressure. The spindle-shaped cells are curiously arranged in bundles running in different directions, and looking like so many bundles of twigs thrown in a confused heap. These cells are chiefly in the outer part of the tumour. The oval cells vary much in size, and the larger ones are probably becoming elongated to form spindles. In a few cells karyokinesis can be seen. The growth is nowhere very vascular. The pigmentation is much more marked in the outer half, and here all the cells appear to contain pigment, but in the lighter parts the colouring material is generally enclosed in rather large round cells.

The growth has penetrated through the root of iris from behind, and appears in the angle of the anterior chamber. It has in its central parts completely destroyed the ciliary muscle, and occupied the ciliary processes, but at the margins it is penetrating between the ciliary muscle and sclerotic, and pushing the former inwards. Its cells are invading the lens (*see* Plate), and small islands of them can be seen in the lens substance between the lamellæ. They appear to have effected an entrance a little distance behind the equator of the

lens, *i.e.*, in a part where the capsule is naturally much thinner and less resistant than anterior to the equator. The exact point was not seen in section, and I cannot say whether each of these islands of cells in the lens is directly continuous with the growth. I do not think they are, for in no section (and many were made) could this be demonstrated. The lens, at the part in contact with the growth, has undergone some degeneration, and the individual fibres have lost their outline, but a little deeper from the posterior surface, at the spot to which the most venturesome group of cells has reached, there appears to be very little change, the lamellæ being merely pushed aside by the intruders. Over the greater part of the growth the choroid and retina can be traced; but at its anterior part, the pars ciliaris retinæ is in some places indistinguishable, and the growth has made its way through the choroid. It is doubtful which was the starting point of this growth, the ciliary body or the choroid more posteriorly. Its microscopic characters do not help much; the outer part looks the oldest, but at both its anterior and posterior border there are young round cells—looking as if it were extending forwards and backwards. The inner layers of the sclerotic are becoming infiltrated by the cells of the growth.

This patient has not been heard of since he left the hospital.

Case XIX (*Reg. No.* 2317).—*Small-celled Sarcoma of Choroid; Extension into Optic Nerve and Episcleral Tissues; Recurrence of Growth in Orbit two months later.*

George F., æt. 70, labourer, admitted April 29th, 1887. Left eye has been failing for "some months," the exact time uncertain, but certainly since "before Christmas." It has been blind for seven weeks, and painful for about the same length of time.

On admission: Left, no p.l. P. half dilated. Media semi-opaque. T. + 2.

April 29. Iridectomy was performed, but pain and tension returning, the eye was excised on May 6th.

Examination after removal.—*Cornea*, linear scar at upper part.

Iris wanting at upper part. *Lens in situ*, partially opaque. *Retina* everywhere detached from choroid, and folded.

A large tumour occupies the greater part of vitreous cavity. It springs from posterior and outer part, and extends forwards on temporal side, as far as ora serrata. It surrounds the O.D., and the retina passes forwards through it as a round cord. The inner layers of the choroid can be traced on its surface over the greater part, but near the equator of the eye the growth has perforated this tissue, and a rounded knob with a narrow neck protrudes through the opening. On section the growth has a dappled appearance, and is soft and friable. On the external surface of the sclera, close to the optic nerve and on its temporal side, is a small nodule of growth, very similar in appearance to the intra-ocular part.

Microscopic Examination.—The tumour is exceedingly vascular throughout, containing very numerous large blood channels. Its structure varies somewhat in different parts. That portion which is beneath the choroid (*external* to it) consists of uniform small round cells closely packed, and often arranged in little clusters. In the portion which has perforated the choroid, the arrangement is not quite the same. Here the growth is much looser in texture, in places looking spongy, and though the individual cells are similar in shape and size, there are numerous small areas where some degenerative process has occurred. In such places the cells scarcely stain at all, and their outlines are often indistinguishable. There is in most of these areas some granular pigment, and they not improbably indicate former hæmorrhages into the growth. Except in these degenerated areas there is scarcely a trace of pigment. Here and there in the growth are isolated large multinucleated cells, irregularly oval in shape, and with their nuclei, four to six or more in number, huddled together in the centre. They are quite unlike ordinary giant cells, both in shape and in the arrangement of their nuclei. The retina is seen merely as fibrous looking bands passing forwards through the growth from the optic disc.

The optic nerve is deeply invaded by the cells of the tumour, which are spreading down along the central vessels. The exact connection between the intra- and extra-ocular parts of the tumour was not made out in the sections.

This patient's mother died, when an old woman, of "polypus in the nose," which had been twice removed at rather short intervals. There was nothing else of importance in the family or personal history.

July, 1887. Patient has now come into hospital again with a large recurrent growth in left orbit—nearly filling that cavity. After removal it is a soft semi-translucent greyish growth, enclosing the optic nerve and tendons of ocular muscles. It has not perforated the conjunctiva, which is stretched over its nodular anterior surface. There are no symptoms of metastatic growths. Microscopic examination of the growth proves it to be a small celled unpigmented sarcoma. The cells are closely packed and altered in shape by pressure. The growth is very vascular and contains numerous blood extravasations. It is imperfectly divided into lobules by fibrous trabeculæ.

The foregoing 19 cases include, with one exception, all the intra-ocular sarcomata excised at Moorfields during the three years from June, 1884, to June, 1887, with the after-history of each patient as far as obtainable. The following brief analysis of them will perhaps be useful.

Of the 19 cases, there were—

Males 14.
Females 5.

The average age of all together was 51. In the males alone 55 ; in the females alone 42. The youngest patient was a female, æt. 33 (Case 5), the oldest a male, æt. 70 (Case 19).

Recurrence of the tumour locally is known to have taken place in two cases, Nos. 1 and 19; in Case 2 the patient died from "sarcoma" (this was on the certificate of death), and in Case 9 there are symptoms pointing to growth in the skull. All the others are known to be now alive and well; except possibly Case 18 who has not been traced. The longest interval which has elapsed without any recurrence is two years (Case 3).

In two (Nos. 7 and 19) there was a definite family history of "tumour," and a doubtful one in Case 17. In

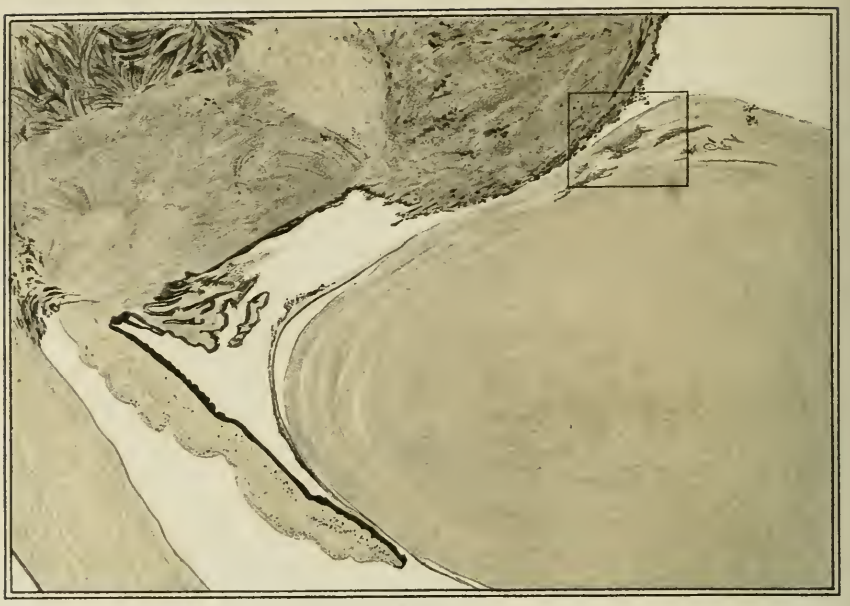


Fig. 1

Cases 1, 8, 9, 14, the family history was perfectly good. In the remainder it was not obtained.

In Cases 4, 14, 15, 16 certainly, and in Case 17 probably, the sarcoma originated in eyes previously blind from other causes.

In five cases (Nos. 4, 8, 13, 14, 17) a history of injury to the affected eye was forthcoming, but in all the interval between the injury and the symptoms of new growth was a long one.

In 11 cases the tension of the eye at the time of excision was increased, in 5 it was normal, in 1 doubtfully increased, and 2 were shrunken eyeballs.

Case 15 has an additional point of interest in that sympathetic ophthalmitis was excited in the sound eye. In reference to this some further notes will be published in a future number of the Reports.

DESCRIPTION OF PLATE.

Fig. 1.—Drawing of section of lens, iris, and anterior part of tumour of Case XVIII, showing the exact relation of these structures, and the point at which the sarcoma cells have penetrated the crystalline lens. (×14).

Fig. 2.—Enlarged drawing, from the same slide, of the portion marked off in Fig. 1, showing the islands of sarcoma in the lens substance. (×90).

Case of Anophthalmos.

(*From a Photograph by the Author.*)

ON ANOPHTHALMOS.

By E. Treacher Collins, *Senior House Surgeon.*

W. J. H., a male child, aged nine weeks, was brought to Mr. Lawson, at Moorfields, on March 25th, 1887, by his mother, who stated that the child was born without eyes. He was her fifth child, born at full time; her third had died of measles, the others were healthy and free from any congenital malformation, as also were all the other members of her and her husband's families as far as she knew. She and her husband were not related before marriage. She states that in the second week of her pregnancy she had a severe fright; some runaway horses rushed past her, and she exclaimed to a companion, "Oh! they have taken my sight away." She felt "upset" for the rest of that day. There was nothing abnormal about her confinement, and no instruments were used; she knows of no cause to which to attribute the malformation beyond the fright, to which she herself does not attach much importance.

On examination the child was quite healthy and well-developed in every other respect; there was no evidence of congenital syphilis, the testes were down, the posterior fontanelle closed, and the anterior open. The palpebral apertures were very small, the right measuring 7 mm. and the left 6 mm., and when I saw the child again on July 4th they had not increased in size, though the child had grown in every other respect, which made it appear, as the mother remarked, as if the eyelids had decreased in size. The lids were small but well formed, and furnished with lashes; no puncta could be seen, but the child shed tears when it cried. The child was examined under an anæsthetic and the lids separated, exposing a conjunctival sac, but no trace of a globe could be felt or seen in either orbit. The accompanying Plate is from a photograph of the child I took when he was five months old. This case is one of a class,

and I have been able to find details of thirty such recorded in various periodicals and other publications. I have also collected all the recorded cases of monophthalmos I can find, and it will be seen below that there are 30 of the former, and only 12 of the latter. Most observers who have written on the subject seem to think that this represents the true state of affairs. Grafe-Saemisch remarks, "as with other anomalies, absence of the eye is more

Cases of Congenital

Number, author, date, reference.	Age at time case reported or to which case lived.	Sex.	Family history.	Other deformities.	Mental and bodily development.
1. J. G. Davey. 1836. Lancet, vol. ii. "Absence of Eyes."	Lived 14 weeks	Not stated	6th or 7th child	None	Emaciated and suffering from enteric affection; convulsed 3 weeks before death
2. D. M. Hudson. 1854. Med. Exam. Phila., vol. x. "Case of Monstrosity."	"New born"	M.	Not given	None	Large and quite healthy
3. L. W. Kinney. 1854. Boston Med. and Surg. Jour. "Case of Malformation."	"New born"	M.	Not given	None	Large and healthy
4. Mr. Poland. R. L. Ophth. Hosp. Reports, vol. i. "Anophthalmos."	"New born"	M.	Three other children, all perfectly natural	None	Plump and well developed

frequently observed to be double than one-sided, and the older works particularly refer almost invariably to bilateral anophthalmos." Landesberg, Wilde, and Jacobi write to the same effect. No doubt many observers would think the absence of both eyes more worthy of record than the absence of one, it is therefore impossible to draw any satisfactory conclusion from reported cases alone. The following are the details of the cases in tabulated form :—

Bilateral Anophthalmos.

Local conditions.		
Lids.	Orbits and contents.	Lacrymal apparatus.
On right side adherent from recent inflammation; on left same process going on	Contained a quantity of condensed cellular tissue, and no vestige of an eye	No note.
On either side of the nose there is "a small carbuncle as it were of a bluish grey cast on the lower eyelids"	Eyeballs absent	No note.
The lowers lids distended and of a dark colour like recent ecchymosis, soft and fluctuating, one being protruded more than the other	The globes of the eyes were entirely wanting	No note.
No eyelashes, upper and lower lids united along the whole extent of their margins	Orbits appeared somewhat smaller than usual: there was no appearance of an eye or of a shrunken globe, for there was nothing to be seen or felt but an immovable slightly raised mass of thickened conjunctival membrane: an incision was made into this, but it only exposed reddish areolar tissue; there was no evidence of any muscles	No note.

Cases of Congenital

Number, author, date, reference.	Age at time case reported or to which case lived.	Sex.	Family history.	Other deformities.	Mental and bodily development.
5. H. Wilson. R. L. Ophth. Hosp. Reports, vol. viii. "Case of Anophthalmos."	Æt. 13	F.	Daughter of cousins, and one of four children, one of whom is said to have died of water on the brain	Prominent mouth, small badly developed lower jaw, high cheek bones. The hands are cramped, the fingers bent on the carpus, and the whole bent towards the forearm, also flexion of the feet	No note
6. P. Gradenigo. 1870. Annales d'oculistiques. "Observation d'un cas d'anophthalmos."	Died 3 years after first note, when she was reported to be a "little girl"	F.	Healthy parents	None	Mental faculties seemed very limited, the senses, except that of sight, perfect, organic functions regular. Bodily development not in proportion to the age of the child
7 and 8. John Walker. 1832. Lancet. "Case of Congenital Deficiency of both Eyes."	Eldest 5 years, younger 4 months	F's.	Sisters, an intermediate child, a boy, unaffected	None	No note

Bilateral Anophthalmos—contd.

Local conditions.		
Lids.	Orbits and contents.	Lacrymal apparatus.
Eyelids are fairly developed, but the palpebral opening is very small, and the edges of the eyelids generally in apposition ; the eyebrows are very badly marked, and hair scanty. The lids are constantly in motion, though the upper one is not raised	The muscles are present and are evidently attached to the conjunctiva or something (? Tenon's capsule) behind it, and are seen to move much as they behave after enucleation	The punctum in each lower lid is present, but I could not see it in the upper lids. Occasionally tears pour over, showing the lacrymal gland to be present.
Eyelids normal in form and structure, palpebral fissure a little small; they were incapable of movement	No rudiments of the eyeballs could be discovered	Lacrymal puncta patent.
The aperture between the lids is very small, not exceeding a quarter of an inch in the transverse direction, but they appear to possess the usual muscular movements	The orbit appears to be occupied merely with common cellular substance, which affords little resistance when the finger is applied over the lids	When the children cry, copious lacrymation takes place, proving the existence of a lacrymal gland, but the tears always roll down the cheeks in consequence of the non-existence of the puncta lacrymalia.

Cases of Congenital

Number, author, date, reference.	Age at time case reported or to which case lived.	Sex.	Family history.	Other deformities.	Mental and bodily development.
9. A. B. Williman. 1848. The Charleston Medical Journal and Review, vol. iii. "Case of Congenital Absence of the Globes of both Eyes."	9 years	F.	The last child of a black woman, who has reared a remarkably fine and healthy family	None	The girl, however, with the loss of the most important of the organs of sense, manifests a singular intelligence in many others. Her disposition is cheerful, hearing is quite acute, and she possesses a remarkable power of distinguishing bodies by the touch
10. A. Schmidt. 1821. Referred to in Weller's Maladies des yeux, under "Congenital Deficiency and Superfluity of the Eyes."	Died at 6 weeks	No note	No note	No note	No note
11. Malacarne Same source as the last case.	Died at 2 months	No note	No note	No note	No note
12, 13, and 14. G. C. Monteath. Note by translator of Weller's book referred to in Case 10.	One died æt. 6, and one in 8th month. Eldest living, æt. 14.	1st male, the 2nd female, sex of other not mentioned.	Three of a family of eight: the first, second, and fourth	All perfectly formed	The two eldest healthy; the other born delicate

Bilateral Anophthalmos—contd.

Local conditions.		
Lids.	Orbits and contents.	Lacrymal apparatus.
At birth the upper and lower lids on both sides were adherent. At the end of a week or ten days there occurred a spontaneous separation for a few lines distance along the tarsal margins; very gentle force exercised with the fingers soon completed the rupture of the remaining adherent portion. The eyelids are perfect and furnished with puncta and eyelashes, and are lined as usual with a healthy conjunctiva	This membrane (*i.e.*, the conjunctiva) extending throughout the entire surface of the orbit was reflected rather firmly over a more resistent tissue, deeply situated (perhaps the rudiments of the sclerotic coat), although beneath this no protrusion was visible, and a probe passed over its surface could detect no openings. The orbital margins are well developed below, but at their superior external portion, appear somewhat deficient	In both cavities there existed the secretion of a fluid resembling the tears, the lacrymal gland being in its normal position, and easily felt by slight pressure. The eyelids are furnished with puncta.
No note	No globe, no optic nerve	Lacrymal glands present.
Eyelids present	No globes	Lacrymal glands, caruncles, and canals present.
The eyelids were perfectly natural. These children have been repeatedly attacked with inflammation of the eyelids and cavity of the orbit. The edges of the tarsi of the eldest have in consequence of the inflammations adhered to a considerable extent, so that the opening into the sockets is now very small	No vestige of any eyeballs	Lacrymal passages natural.

Cases of Congenital

Number, author, date, reference.	Age at time case reported or to which case lived.	Sex.	Family history.	Other deformities.	Mental and bodily development.
15. A. V. Hippel. 1874. Von Græfe's Archives, vol. xx. "Anophthalmia Duplex Congenita."	15 years	F.	Parents healthy, not related; no case of deformity in family	None	Moderately developed for her age; powers of intelligence of rather low order; bones of skull undoubtedly abnormal
16. R. Liebreich. 1873. St. Thomas's Hosp. Reports, vol. iv, p. 135. "Anophthalmus Congenitus."	8 days	No note	No note	No other anomalies whatever	Well grown, heavy, and fully developed
17. G. Strawbridge. 1871. Transactions American Ophthalmological Society, p. 144. "Congenital Absence of both Eyeballs," Two Cases.	Died at 5 weeks.	No note	No note	None	Finely developed
18. Same source.	7 years	M.	No note	None	Finely developed
19. Wordsworth. 1881. Lancet, Nov. 19, vol. ii, p. 875.	7 weeks	No note	Parents were healthy, and had several well developed children; and there was no history of hereditary or other influence to account for the arrest of development	None	Child well formed and healthy

Bilateral Anophthalmos—contd.

Local conditions.		
Lids.	Orbits and contents.	Lacrymal apparatus.
The palpebral apertures run up and out obliquely, length normal, can be opened a little with great effort, entropion of upper lids, ectropion of lower. The lower lids are much thickened, and below the margin is a noteworthy swelling under the skin which eludes the grasp	Left side, a small round cyst-like mass, the covering of which is very thin, and at some parts nearly transparent, at the same time somewhat uneven, seems filled, fluid, and about the size of a pea. Right side, no cyst-like body like the above; at the bottom of conjunctival sac a small canal	Canaliculi and ducts present; no lacrymal glands made out.
The eyelids were closed, and could not be separated; the narrow slit of the eyelids, bordered with lashes, showed only a very small opening, from which the tears escaped	There was no orbit, but instead of this a bony surface uniting the supra- and infra-orbital borders which lay very near to each other. There existed a small rudiment of the conjunctival sac; all other contents of the orbit were wanting	Probably a rudiment of the lacrymal gland was present.
Well developed	Conjunctiva ends in a *cul-de-sac* without a trace of optic nerve	Lacrymal gland largely developed. No puncta lacrymalia or canaliculi, although there would seem to have been an effort made toward the formation of a nasal duct.
No note.	Similar to case above	No note.
Normally formed lids, very small fissures	Orbits of fair size; both orbital cavities were seen to be void, and little or no trace of the eyeballs was evident	No note.

Cases of Congenital

Number, author, date, reference.	Age at time case reported or to which case lived.	Sex.	Family history.	Other deformities.	Mental and bodily development.
20. J. P. Wall. 1881. The Medical Record, New York, vol. xix, p. 358. "Congenital Absence of Eyeballs."	6 months	M.	No note	None	The child is well grown for its age, intelligent, and seems all right in every other respect
21. M. Landesberg. 1877. Klin. Mon. für Augenheilkunde, vol. xv, p. 141. "Four Cases of Congenital Anophthalmos."	4 weeks	No note	Parents healthy, first cousins; father has had syphilis; four other children healthy; no other deformity in family	Right side of face broader than left; nose slants to left. Hare-lip on left side	Badly nourished; born prematurely
22. L. De Wecker. 1876. Klin. Mon. für Augenheilkunde, vol. xiv, p. 329. "Case of Anophthalmos with Congenital Cyst Formation in Lower Lid."	6 months	No note	No note	None	Healthy, well formed
23. Wickerkiewicz (de Posen). 1879. Klin. Monatsblätter für Augenheilk. and Recueil D'Ophthalmologie, p. 757. "Bilateral Anophthalmia."	3 years	No note	No note	No note	No note

Bilateral Anophthalmos—contd.

Local conditions.		
Lids.	Orbits and contents.	Lacrymal apparatus.
Lids perfectly formed but small	No eyeballs present even in a rudimentary form	Shed tears.
Eyebrows and cilia scanty; lids normal, but palpebral apertures small	No eyeballs	Right lacrymal gland badly developed; left absent. Caruncle and puncta present on both sides.
Two blue swellings on each lower lid, which get more blue when child cries, these were cut into and found to be thin-walled fluctuating cysts containing fluid, which on analysis proved to resemble aqueous humour more than cerebro-spinal fluid Cysts had no connections posteriorly that could be felt Some ectropion of lower lids, especially of right; tarsus normal	Deep well-formed conjunctival sacs ending in a funnel shape on both sides; no eyeballs or any any trace of them	No tears.
No note	Not the least trace of the eyeballs could be found on either side; cavities of the orbit about 1 cm. in depth and lined by conjunctiva	No note.

Cases of Congenital

Number, author, date, reference.	Age at time case reported or to which case lived.	Sex.	Family history.	Other deformities.	Mental and bodily development.
24. Bartscher. 1857. Journal für Kinderkrank, vol. xxvi, p. 78–81, and Annales d'Oculistiques, vol. xxxvii, p. 80. "Case of Congenital Anophthalmos of both Eyes."	Died 3 days after birth	No note	No note	Double hare-lip, fissure of hard and soft palates; six fingers on both hands, the 6th having only two phalanges	Ill developed
25. Guépin. 1842. Annales d'Oculistiques, vol. vii, p. 182. "Congenital Absence of both Eyes."	7 years	M.	No note	None	Well developed and very intelligent; the organs of touch, taste, and smell very acute
26. Sissa. 1851. Gazetta Medica Italiana and Annales d'Oculistique, vol. xxvi, p. 190. "Case of Anophthalmos."	Died 5 days after birth	F.	Born at full time of healthy parents	None	Well formed
27. Gauran. Union Méd. de la Seine Inf. and Recueil d'Ophthalmologie, vol. vi, p. 374. "Absolute Bilateral Anophthalmos."	7 months	No note	The third child of healthy parents; its brother and sister are well formed; the parents are not related	None	Well developed
28. Meyer (de Bruges). 1849. Annales de la Société Médic.-Chir. de Bruges and Annales d'Oculistique, vol. xi, p. 171. "Anophthalmos."	4 months	F.	Born of healthy parents	None	In good health

Bilateral Anophthalmos—contd.

Local conditions.		
Lids.	Orbits and contents.	Lacrymal apparatus.
Lids united as far as the lacrymal puncta on both sides	No eyeballs	No superior canaliculus.
No ankyloblepharon, palpebral aperture small	The orbital cavities considerably reduced in size No eyeballs	The interior of the lids were moist, but much less watery than 5 years ago, which led to the supposition that the lacrymal gland had atrophied.
The palpebral apertures were only two lines long, lids rudimentary.	The orbital cavities of smaller capacity than normal, a small round body the size of a grain of maize could be felt No eyeballs	The puncta lacrymalia existed.
Eyelashes and eyebrows present, lids well formed: it could raise the upper lid, showing the presence of a levator palp. sup.	Not the least vestige of an eyeball	No tears.
Well formed, and furnished with lashes; they are adherent with only a slight separation on right side, and for two-thirds of their extent on the left	No eyeballs	No note.

Cases of Congenital

Number, author, date, reference.	Age at time case reported or to which case lived.	Sex.	Family history.	Other deformities.	Mental and bodily development.
29. Michel. 1878. Von Græfe's Archiv. für Ophthalmologie, p. 71. "A Case of Bilateral Anophthalmos."	Died soon after birth	No note	No note	No opening of the nose externally; palatine fissure. Skull deformed	No note
30. Röder. 1863. Klin. Monatsbl. f. Augenheilk, p. 494.	Died on 11th day	No note	No note	No note	Functions regular until death

Cases of

Number, author, date, reference.	Age at time case reported.	Sex.	Family history.	Other deformities.	Mental and bodily development.
1. J. Hutchinson. 1866. R. L. O. H. Reports, p. 326. "Case of a Child born with one Eye deficient and the other shrunken."	5 weeks	No note	6th child; all the others reported to be healthy	Talipes calcaneum of the right foot	Exceedingly puny, and unable to make any noise in crying
2. G. Strawbridge. 1871. Reference given above.	3 months	No note	No note	No note	No note

Bilateral Anophthalmos—contd.

Local conditions.		
Lids.	Orbits and contents.	Lacrymal apparatus.
Palpebral aperture measured 11·5 mm. on the right side and 10·5 on the left; the eyebrows were entirely wanting; the lids badly developed with delicate small eyelashes; there was some entropion; the margins of the lids were united except a narrow opening in the centre	The margins of the orbit can be felt; the cavity itself is very constricted, especially in the vertical direction, and within it can be felt a loosely embedded oval round knot about the size of a pea, slightly elastic like the consistence of cartilage	The canaliculi and lacrymal puncta were not found.
Lids badly developed; palpebral fissures narrow; eyelashes present	No trace of eyeballs	Lacrymal gland present.

Monophthalmos.

Local conditions.			Condition of the other eye.
Lids.	Orbit and contents.	Lacrymal apparatus.	
The palpebral apertures were very narrow, but the lids were perfect	Right orbit, no trace of eyeball.	The child shed tears when it cried	In the left orbit the bulb of the collapsed globe was distinguished by the remains of a small portion of cornea, with a scar on it and a tag of adherent iris.
No note	Absence of one eyeball	No note	In the other a large coloboma of iris and choroid.

Cases of

Number, author, date, reference.	Age at time case reported.	Sex.	Family history.	Other deformities.	Mental and bodily development.
3. Talko. 1872. Klin. Monatsbl. f. Augenheilk. vol. x, p. 268. "Case of Congenital Monophthalmos."	17 years	F.	No note	No note	No note
4. Jacobi. 1874. Klin. Monatsbl. f. Augenheilk. vol. xii, p. 260. "Monophthalmos and Microphthalmos."	5 months	No note	Two healthy sisters and healthy parents	None	Well developed; hears well
5. Landesberg. 1877. Reference given above.	3 months	No note	No family history; parents not related	None	No note
6. Same source as last.	4 years	No note	Parents not related; mother healthy; father subject of monophthalmos, see next case	None	Well nourished and fully developed
7. Same source as last.	25 years	M.	Father of last case: parents died when he was young; no abnormality; his 2nd child has good eyes	None	Well developed bodily and mentally
8. Galezowski. 1880. Recueil d'Ophthalmologie, p. 124. "Anophthalmos, a complete Congenital Absence of one Eye."	10 days	M.	No note	No note	No note

Monophthalmos—contd.

Local conditions.			Condition of the other eye.
Lids.	Orbit and contents.	Lacrymal apparatus.	
Lids small and short, palpebral aperture 8 mm. long, eyelashes and eyebrows badly developed	No trace of eyeball on right side	Canaliculi badly developed	Keratitis of left.
Palpebral fissure narrow	Left no eyeball, cyst the size of a pea	No note	Right side a small eyeball.
Lids normal, palpebral aperture slightly smaller than on opposite side	Right orbit of normal size, no eyeball, a round nodule felt	Normal	Left eye and lids normal.
Eyelids well-formed, palpebral fissure narrower than on opposite side	On left side no globe or anything like it	Normal	Right eye normal.
Lids smaller and palpebral fissure much shorter than on opposite side; eyelashes in upper lid white and thick, black in lower lid and scanty	Right orbit flat and shortened, no globe or rudiment of one	Upper puncta and lacrymal gland absent	Left eye normal, hypermetropia.
No note	Left orbit smaller than normal, and did not contain any eyeball	No note	Ophthalmia neo-natorum in right eye.

Cases of

Number, author, date, reference.	Age at time case reported.	Sex.	Family history.	Other deformities.	Mental and bodily development.
9. Same source as last.	9 years	F.	Eldest sister blind from ophthalmia neo-natorum; 2nd sister died of convulsions, and a brother at one year old of aneurism; another sister well, and with good eyes	No note	Child healthy
10. Same source as last.	24 days	F.	No history of abnormalities in the family; mother and father not related; 6th child; four others living and well, one born dead	No note	No note
11. C. E. Smith. 1880. British Medical Journal, vol. ii, p. 169.	2 months	No note	Father and mother healthy; family history perfect. Mother was a multipara, but the other children died of convulsions	None	Healthy and fully developed
12. A. D. Davidson. 1880. Transactions of the Ophthalmological Society, vol. i, p. 216. "Case of Congenital Absence of right Eyeball."	19 weeks	F.	No note	None	Well grown and in good health

Age.—The oldest case of bilateral anophthalmos was 15 years; ten died within two months of birth, one at fourteen months, and another at four years.

Among the cases of monophthalmos, one was recorded 25 years old, another 17 years, and all the cases were living at the time they were reported.

Monophthalmos—contd.

Local conditions.			Condition of the other eye.
Lids.	Orbit and contents.	Lacrymal apparatus.	
No note	Left orbit relatively small, complete absence of eyeball or any stump representing it	No note	Right eye amblyopic and hypermetropic; lateral nystagmus.
No note	The circumference of right orbit not sensibly different from left, right eyeball absent	Tears secreted	No note.
Lids and appendages of the left eye were quite normal	There was not the slightest trace of any globe on the left side	No note	The right eye was natural.
The right palpebral fissure was found to be somewhat smaller than the other	The right orbit seemed of full size in front and full depth; conjunctival sac well-formed and of good size, a small round button was felt under the normal conjunctiva	Tears abundant	In the left eye the optic disc was greyish and not quite clear, but probably healthy.

Sex.—Both sexes seem almost equally liable to this malformation; out of the 31 bilateral cases, 8 were males and 9 females; in 14 no mention of sex was made. In the 12 cases of monophthalmos, 2 were males and 4 females; in 6 the sex is unrecorded.

Family History.—In one case only, of monophthalmos.

was there a history of a similar abnormality in a parent (*vide* Cases 6 and 7). In two of the bilateral cases it was reported that mother and father were cousins. In one family two were affected out of three, the intermediate boy escaping; and in another family three, the first, second, and fourth, out of eight, exhibited this condition. In most of the other cases there were other children in the family, and they were unaffected.

Other Deformities.—In 23 out of 31 cases no other deformity was reported; in four there were no notes as to other deformities. Of the remaining four, one had left-sided hare-lip; another double hare-lip, and six fingers on each side; a third had a palatine fissure, a deformed skull, and no external opening of the nose; the fourth had a badly developed lower jaw, fingers flexed on the carpus and hands on the forearms, also flexion of the feet. In the monophthalmic cases only one deformity was reported, viz., talipes calcaneum of the right foot.

Mental and Bodily Development.—Three of the children with bilateral anophthalmos were said to be very intelligent, and two were said to be rather stupid. The majority were said to be healthy and well developed, but five were puny and below the average size.

The rule for this class of cases then seems to be that they are born of healthy parents unrelated, and are themselves healthy and well formed and free from abnormalities with the exception of the one in question. That it affects males and females equally, and that in all probability none live to puberty.

Local Conditions.—(*a*) *Lids.* The palpebral apertures and lids in nearly all the cases were described as being very small though well developed. In nine cases there was more or less ankyloblepharon, and in four cases cyst-like swellings in the lower lids beneath the skin were mentioned, three of which were described as being of a blue colour. (*b*) *Orbits and Contents.* The orbits were recorded as smaller than normal in eight cases, five of the

bilateral and three monophthalmic; and in only three were they of normal size, one bilateral and two monophthalmic. In one case (No. 16) there was no orbit at all. The conjunctival sac was present in all, but very small in No. 16. In four cases (two monophthalmic and two bilateral) a firm resisting knot was described as being felt at the bottom of the orbit, and in two others small cysts were seen. (*c*) *Lacrymal Apparatus.* The lacrymal gland was supposed to be present in 14 bilateral cases and 2 monophthalmic cases, and absent in 5 cases. There was considerable difference in the arrangement of the puncta lacrymalia and canaliculi; in some they were all present; in others all absent; and in others again present in one lid and not in the other.

Condition of other Eye in Monophthalmos.—In six cases the other eye was reported as normal; in two it was microphthalmic; in one there was coloboma of the iris and choroid, and in one it was amblyopic and nystagmic.

Of the 12 cases six had the right eye absent and five the left, in one there is no note.

These cases give rise to the following interesting questions:—

(1.) Does an eyeball in a very rudimentary state exist far back in the orbit, so small and mobile that it cannot be detected by sight or touch, or are they cases of true anophthalmos?

(2.) What is the condition of the optic nerves and brain in these cases?

(3.) What is the cause of this malformation? Do maternal impressions or frights during pregnancy have anything to do with it?

In nine of the above cases of bilateral anophthalmos post-mortem examinations were made, the details of which I have tabulated below.

Number. Author.	Contents of orbit.	Condition of optic nerve.	Condition of brain.
1. J. G. Davy.	The orbital roofs were then removed and disclosed the presence only of condensed cellular tissue, which, when cautiously dissected away, exposed the several muscles which naturally belong to the organ of vision, supplied with their respective nerves; the periosteum and cellular substance in the orbit afforded the muscle attachments, in place of the tunica sclerotica It is particularly worthy of notice that on neither side was the levator palpebræ superioris present	The optic commissure was placed more posteriorly than natural, the sella turcica being much anterior to it. From its fore part, and in the median line, the rudiment of it was continued; it was of a loose texture and a scarlet hue, as if from injection of its vessels. It proceeded into the substance of the pituitary gland, where it was lost. Several small bloodvessels passed through the foramen opticum	The calvaria was so firmly adherent to the dura mater that their separation was avoided, the membrane being cut through in the circumference of the head; the parts beneath were exposed. The brain was much congested; the sinuses were filled with blood. On raising the anterior lobes of the cerebrum, only one olfactory nerve was seen.
6. P. Gradenigo.	All the muscles were present and passed forwards, and were inserted into a fibrous membrane, which seemed to take the place of the sclerotic; not the slightest vestige of an eyeball could be discovered. The lacrymal gland was present. The posterior and long ciliary arteries were the only branches of the ophthalmic that were wanting; the ophthalmic artery alone passed through the optic foramen; nerves supplying the muscles were present; the long and short ciliary nerves were absent	The optic nerves were abortive, also the central portion of the chiasma	The corpora quadrigemina existed in the embryonic state, and the corpora geniculata, internal and external, were hardly recognisable.

Number. Author.	Condition of orbit.	Condition of optic nerve.	Condition of brain.
10. A. Schmidt.	Lacrymal gland, third pair of encephalic nerves, and the ophthalmic artery only present	The optic nerve was entirely wanting, and the foramen through which it ordinarily passes was completely obliterated, or rather did not exist	No note.
11. Malacarne.	There were found in the orbit only the lacrymal gland and caruncle the eyelids and lacrymal canals	No note	No note.
17. Strawbridge.	Lacrymal gland present	No trace of an optic nerve	No note.
24. Bartscher.	No conjunctival sac; lacrymal gland replaced by fatty tissue; no glandular structure; dura mater ended in a *cul-de-sac* in orbit No ocular muscles; 3rd and 4th nerves absent, also ciliary ganglion	Optic nerves ended in cone shape at the optic foramen	Cerebellum and spinal cord normal.
26. Sissa.	The lacrymal apparatus seemed completely developed, no trace of an eyeball in either orbit	The optic tracts were developed as usual, but on reaching the orbits they ended in a filament which was lost in the cellular tissue	The corpora quadrigemina and optic thalami were very small.
30. Röder.	All the muscles present and attached to fibrous membrane in orbit, the nerves to the muscles also present and the lacrymal gland	No trace of optic nerves or chiasma, except a fibrous band which runs with ophthalmic artery to the optic foramen	Brain is in too bad a state of preservation to be examined.

Number. Author.	Contents of orbit.	Condition of optic nerve.	Condition of brain.
29. Michel.	A small round body in each orbit, found to consist of true cartilage tissue with numerous cartilage cells, and surrounded with connective tissue and muscle fibres arranged irregularly; at the anterior and outer side of this piece of cartilage was some glandular tissue similar in structure to the lacrymal gland. Not the smallest trace of an eyeball, or any tissue like it, could be discovered	The optic nerve, chiasma, and optic tract were wanting. No optic foramen on either side	The cerebrum very hyperæmic, consisted of only one hemisphere; the falx cerebri coursed in an oblique direction from the left anteriorly to the right posteriorly, let in between the hemisphere and the cerebellum, which was pushed to the left. No corpora quadrigemina; no olfactory nerves; optic thalamus, &c., of right side were present. Peripheral nerves could be traced on both sides, the abducens, the supra- and infra-orbital, and the branch of the motor oculi to the levator palpebræ muscle.

Not in any of these nine cases could the least trace of an eyeball, or of anything representing it be found; fibrous tissue and in one case cartilage, which probably correspond to Tenon's capsule, and the sclerotic were found, but nothing else. Not in any case was the optic nerve found to enter the orbit; in one it ended in a cone shape at the optic foramen, in another in a fibrous filament, and in five the chiasma was absent. What had happened then in these cases was this, that no primary optic vesicle had budded out from the anterior primary encephalic vesicle, or having budded out it had failed to form a secondary optic vesicle. It will be seen that the olfactory nerve of one side was reported absent in the first case, and of both sides in the last case, as well as one of the cerebral hemispheres; these also are expansions of the anterior primary encephalic vesicle. So it would appear that some disturbance affecting the development of this anterior primary encephalic vesicle is at any rate one cause of anophthalmos. In four cases a cystic formation in the lower lid is mentioned, and in three of them it is described as of a blue colour: this extraordinary formation, taken together with the absence of the globes, leads one to suppose that it might possibly be a misplaced rudimentary eye. Unfortunately, none of these cases have been dissected, though De Wecker, in his case, cut into one of the cysts, analysed the fluid which escaped, and found it to correspond more to aqueous than to cerebro-spinal fluid. We can imagine the secondary optic vesicle failing to oppose itself exactly to the in-growing process of cuticular epiblast passing beneath it, and growing forward into the lower lid and there forming a cystic tumour, but whether this has actually occurred it is impossible to say without further evidence. In two cases the optic foramen was closed, in three the corpora quadrigemina were reported small or absent, and the optic thalami were also said to be small in one case.

It is interesting to note in the entire absence of the

eye, that its appendages—which are developed from cuticular epiblast and mesoblastic tissue—should reach to the state of perfection which they do. More especially is this interesting when we compare them with a class of cases called cryptophthalmos, which have been very carefully investigated and recorded by Dr. E. Hocquart, in Vol. I, p. 289, of Archives d'Ophthalmologie, in an article entitled "Étude sur un cas de Cryptophthalmos Bilateral." This article also contains a very useful bibliography of the subjects of anophthalmos and cryptophthalmos. He gives the results of four *post-mortem* examinations, in all of which a rudimentary eye was found, the process of development apparently being arrested at the formation of the lens. The parts of the eye in these cases developed from the secondary optic vesicle were described as perfect in structure, but the lids and conjunctival sacs, and parts developed from mesoblast and cuticular epiblast, were wanting or malformed.

With regard to the third question: What is the primary cause of this abnormality? neither hereditary influence nor consanguinity of parents has been shown to account for the large majority of cases. In 12 cases, including my own, some maternal impression or fright is mentioned as having occurred during pregnancy. The particulars are as follows:—Seeing her husband fighting during the first month; seeing suddenly a person with one eye in the first month; seeing a child in a fit with its eyes rolled up on the fifteenth day; visiting a blind asylum daily during her whole pregnancy to see her blind daughter; fright at seeing a rattlesnake in first month; calling to see a friend who was dying in tenth week; seeing a man with one eye during second month; fright at seeing a person with double hare-lip in third month; fright from being attacked by a dog with one eye in fourth month; and fright from being struck on the eye with a piece of wood in fifth month.

If, as I have shown, the abnormality be due to a non-

formation of either the primary or secondary optic vesicle, the exciting cause must occur very early in the course of pregnancy, since commencement of the optic vesicle has been seen in the embryo chick on the fourth day. I think, therefore, that with the exception of the first five cases, and of my own case, we may say that the supposed impression was a coincidence and not related with the abnormality, but to the others, in the absence of any other known cause. I think some credence may be attached.

INDEX TO VOL. XI.

PAGE

Accommodation, action of mydriatics on 219
—— action of myotics on .. 130
—— argument for meridional .. 345
—— failure of, in prolonged lactation 347
Age in relation to liability to sympathetic ophthalmitis .. 305
Amblyopia, acute, from tobacco 70
—— and night-blindness, pedigree of family with 371
—— and nystagmus, pedigree of family with 367
—— central, in a diabetic smoker 72
—— congenital and infantile .. 353
—— —— with marginal thickening of cornea 77
—— feigned, uniocular, in child 344
—— in ametropia 362
—— in convergent strabismus, explanations of 384
—— tobacco, case of unsymmetrical 188
—— uniocular, without signs of disease 377
—— with day-blindness .. 372
—— without ophthalmoscopic changes 358
Anophthalmos 429
—— autopsy in 450
—— influence of maternal impression on 454

Barrett (and Lang), Action of mydriatics on accommodation 219
—— —— Refraction of eyes of mammalia 103
Brailey, Intra-ocular sarcoma exciting sympathetic disease 53
Benson, Modern operations for trichiasis 18

Capsulo-pupillary membrane, persistent 345
Cataract extraction, with and without cocaine, statistics of 341
—— neuralgia in 57

PAGE

Cataract, slow maturation of .. 344
Cats, refraction of eyes of .. 122
Choroid, central changes in, after blow 59
Choroiditis in connection with myopia.. 73
—— syphilitic, continued micropsia after 62
—— —— pathological changes in 1
Choroido-retinitis, central, probably from exposure to sunlight 76
—— with pigmentation of mucous membrane 216
Cocaine in cataract extraction, statistics 341
Collins, W. J., Miscellaneous cases and observations .. 343
Collins, E. T., Notes on inpatients 338
—— On anophthalmos 429
Colour-blindness, amblyopia and day-blindness with total .. 372
Congenital amblyopia 353
Cornea, marginal thickening of, in congenital amblyopia .. 77
—— node in, in late stage of syphilis 270
—— symmetrical ulcers of .. 58
—— ulceration of, in interstitial keratitis 338
Cows, refraction of eyes of .. 118
Curator's Pathological Report (Milles) 26
—— (Lawford) 196
—— (Lawford) 327
—— (Lawford) 400
Cystic degeneration of retina .. 208

Day-blindness with congenital amblyopia 372
—— with total colour-blindness 372
Deer, refraction of eyes of .. 125
Dogs, refraction of eyes of .. 125

Embolism of both central retinal arteries.. 265

PAGE

Embolism of central retinal artery following cerebral symptoms 268
Eserine, action of, on accommodation 130
—— action of, on presbyopes .. 158
Eyes containing foreign bodies at excision 196

Foreign bodies in eyes at excision 196
Fovea centralis, peculiar reflex from, in myopia 351

Glaucoma, syphilitic iritis after 64
Guinea-pigs, refraction of eyes of 113
Gunn, Retinal reflexes visible with ophthalmoscope.. .. 348
—— Sympathetic inflammation of the eyeball 78, 273

Hæmorrhage behind lens from injury, persistent or relapsing 62
—— central sub-retinal, from straining 61
Homatropine, action of, on accommodation 220
—— with cocaine, action of, on accommodation 228
—— —— and eserine, action of, on accommodation 247
—— with eserine, action of, on accommodation 239
Horses, refraction of eyes of .. 120
Hutchinson, J. Jun., Choroido-retinitis with peculiar pigmentation of mucous membranes 216
—— Relapsing optic neuritis with development of new vessels in front of papilla 191
—— Unsymmetrical tobacco amblyopia 188
Hyæna, refraction of eyes of .. 126

Infantile amblyopia 353
—— —— diagnosis of 355
—— —— without ophthalmoscopic changes.. 358
In-patients, notes on 333
Iris, change in colour of healthy 272
Iritis, chronic, in later stage of syphilis 270
Iritis, syphilitic, in old glaucomatous eye 64
Irido-chroroiditis, uniocular, from meningitis 64

PAGE

Jackal, refraction of eyes of .. 125

Keratitis, interstitial, corneal ulceration in 338

Lactation, accommodative failure in prolonged 347
Lang (and Barrett), Action of mydriatics on accommodation 219
—— —— Action of myotics on the accommodation 130
—— —— Refraction of eyes of mammalia 103
Lawford, Cases of cystic degeneration of retina 208
—— Cases of intra-ocular sarcoma 400
—— Dislocation of crystalline lens 327
—— Eyes containing foreign bodies at excision 196
Lens, cases of dislocation of .. 327
—— hæmorrhage behind .. 62
Locomotor ataxy, mydriasis without equivalent cycloplegia in 260

Mammalia, refraction of eyes of 103
Mice, refraction of eyes of .. 116
Micropsia, long continuance of, after syphilitic choroiditis .. 62
Milles, Cases of sympathetic ophthalmitis 48
—— detachment of the vitreous body 26
—— sympathetic ophthalmitis from intra-ocular sarcoma .. 43
Miosis, in irritation of eye .. 56
Mongoose, refraction of eyes of 126
Monkeys, refraction of eyes of.. 126
Monophthalmos.. 442
Mucous membranes, pigmentation of, with choroido-retinitis 216
Mydriasis (uniocular) without cycloplegia .. 261, 263, 264
—— without equivalent cycloplegia in locomotor ataxy .. 260
Mydriatics, action of, on accommodation 219
Myopia, peculiar foveal reflex in 351
—— rapid increase of, in adult 73
Myotics, action of, on accommodation 130

Nettleship, Miscellaneous observations and cases .. 55, 260

	PAGE
Nettleship, Pathological changes in syphilitic choroiditis and retinitis	1
—— Some forms of congenital and infantile amblyopia ..	353
Neuralgia in cataractous eyes ..	57
Night-blindness and amblyopia, pedigree of family with ..	371
—— varieties of..	368
Nystagmus and amblyopia, pedigree of family with ..	367
—— uniocular, in three hypermetropic brothers	75
Ocular irritation, miosis in ..	56
—— muscles, paralysis of external, in child	343
Opossum, refraction of eyes of	126
Optic atrophy from orbital cellulitis after scarlatina	65
—— disc, vascular supply of ..	57
—— neuritis, relapsing.. ..	191
—— —— uniocular, in fever ..	66
Orbital cellulitis after scarlatina	65
Papilla, new vessels in front of	191
Paralysis of external ocular muscles in child	343
Peccary, refraction of eyes of ..	126
Persistent capsulo - pupillary membrane	345
Pilocarpine, action of, on accommodation	175
Porcupine, refraction of eyes of	126
Presbyopes, action of eserine on	158
Rabbits, refraction of eyes of ..	105
Rats, refraction of eyes of ..	117
Refraction of eyes of mammalia	103
Retina, central changes in, after blow	59
—— concussion of, with hæmorrhages	60
—— cystic degeneration of ..	208
—— double embolism of central artery of	265
—— double thrombosis of central artery of	269
—— embolism of central artery of, following cerebral symptoms	268
—— hæmorrhage beneath, from straining	61
—— radiated striation of, after blow	59
—— watered silk reflex from ..	348
Retinal hæmorrhage, complete absorption of pigment in ..	271
—— —— from retching ..	271
—— —— in tobacco amblyopia	70, 71
—— reflexes visible with ophthalmoscope	348
Retinitis, albuminuric, during pregnancy	67
—— syphilitic, late condition ..	63
—— —— pathological changes in	1
Sarcoma, intra-ocular, cases of..	400
—— —— exciting sympathetic ophthalmitis 43, 53,	417
Strabismus, amblyopia in convergent	384
Sympathetic irritation, oscillation of pupil in	324
—— ophthalmitis .. 78,	273
—— —— cases of	48
—— —— character of different types of	313
—— —— effects of treatment in	318
—— —— exciting eye lost from panophthalmitis . ..	323
—— —— final condition of sympathising eye in	314
—— —— exciting eye in ..	317
—— —— from intra-ocular sarcoma 43, 53,	417
—— —— hypopyon in.. ..	324
—— —— interval in	309
—— —— liability to, at different ages	305
—— —— occurrence of, after excision	322
—— —— recurrent keratitis punctata in	323
—— —— relation of character of inflammation and final condition to interval	317
—— —— relation of character of inflammation and final condition to age	315
—— —— relation of character of inflammation and final condition to nature of primary lesion	316
—— —— relation of interval to age	311
—— —— treatment of.. ..	321
Syphilis, affection of cornea and iris in late stage of	270
Syphilitic choroiditis and retinitis, pathology of	1

PAGE

Syphilitic choroiditis, continued micropsia after 62
—— iritis in old glaucomatous eye 64
—— retinitis, late condition .. 63

Tobacco amblyopia, acute, with retinal hæmorrhage .. 70, 71
Tobacco amblyopia, case of unsymmetrical 188
Trachoma, treatment of with carbolic acid 340
Trichiasis, modern operations for 18
Thrombosis of both central retinal arteries 269

Vitreous, detachment of the .. 26

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